US ROUTE 460 DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SUPPLEMENTAL AIR TECHNICAL REPORT

USACE FEDERAL PROJECT NUMBER: NAO-2008-03470 | FHWA FEDERAL PROJECT NUMBER: STP-000S (276) STATE PROJECT NUMBER: 0460-969-059, P101, C501; UPC: 100432

JUNE 2016









ROUTE 460 LOCATION STUDY: FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENTAL AIR QUALITY ANALYSIS TECHNICAL REPORT



FHWA PROJECT NUMBER STP-000S (276)
USACE PROJECT NUMBER NAO-2008-03470
VDOT UPC 100432; PROJECT NUMBER 0460-969-059, P101, C501

June 2016

ROUTE 460 LOCATION STUDY PRINCE GEORGE, SUSSEX, SURRY, SOUTHAMPTON AND ISLE OF WIGHT COUNTIES AND THE CITY OF SUFFOLK FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

FHWA Federal Project Number: STP-000S (276)

USACE Federal Project Number: NAO-2008-03470

State Project Number: 0460-969-059, P101; C501 UPC: 100432

AIR QUALITY ANALYSIS TECHNICAL REPORT

PREPARED FOR:

THE VIRGINIA DEPARTMENT OF TRANSPORTATION

June 2016

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Air Quality analysis	2
1.2	Background	2
1.3	Purpose and Need	3
1.4	Final SEIS Alternatives	4
1.4	4.1 No Build Alternative	4
1.4	4.2 FHWA/VDOT Preferred Alternative	5
2.0	SUMMARY	6
3.0	TRAFFIC SUMMARY	7
4.0	EXISTING CONDITIONS	7
5.0	METEOROLOGY CLIMATE	7
6.0	REGULATORY STANDARDS	8
6.1	National ambient air Quality Standards	8
6.2	Mobile Source Air Toxics	8
7.0	PROJECT ASSESSMENT	10
7.1	Carbon Monoxide (CO) Analysis	10
7.1	1.1 Methodology	10
7.1	1.2 Interchanges/Intersections Studied	10
7.1	1.3 MOVES Emissions Estimation	15
7.1	1.4 CAL3QHC Dispersion Model	16
7.1	1.5 Receptors	17
7.1	1.6 CAL3QHC Modeling Results	21
7.2	Particulate Matter	22
7.3	Mobile Source Air Toxics Analysis	22
7.3	3.1 Methodology	22
7.3	3.2 MSAT Background	23
7.3	3.3 MOVES	23
7.3	3.4 MSAT Research	24
7.3	Project MSAT Impacts	25
7.3		-
7.3	3.7 MSAT Conclusions	28
8.0	CLIMATE CHANGE AND GREENHOUSE GAS IMPACTS	28

8.1	Daily Vehicle Miles Traveled Regionwide	29
8.2	Vehicle Speeds and Delay	29
8.3	Construction and Maintenance	30
9.0	CONSTRUCTION EMISSION ANALYSIS	31
10.0	CONCLUSION	31
LIST (OF ACRONYMS	33
LIST	OF APPENDICES	
APPEN	VDIX A: Traffic Analysis (Available upon request)	
APPEN	IDIX B: Sample MOVES Input and Output Files (Complete set of files available upon request)	
APPEN	IDIX C: Sample CAL3QHC Input and Output Files (Complete set of files available upon reque	st)
	NDIX D: CAL3QHC Table of Peak CO Concentrations by Receptor for Each Alternative (1-Hour) at Each Worst Case Interchange	Iour
LIST	OF TABLES	
Table 1	-1: No Build Projects within the Route 460 Study Area Jurisdictions	5
Table 6	-1: National Ambient Air Quality Standards	9
Table 7	-1: Existing, Interim and Design Year Average Daily Traffic (ADT)	12
Table 7	-1: Existing, Interim and Design Year Average Daily Traffic (ADT) (cont.)	13
	-2: Existing, Interim and Design Year Projected LOS and Peak Hourly Volumes	
Table 7	-3: Summary of MOVES Inputs	15
	-4: Summary of MOVES CO Emission Factors	
	-5: Summary of CAL3QHC Inputs	
	-6: CAL3QHC Modeling Results for the Eastern Terminus Intersection/Interchange	
Table 7	-7: Daily VMT Estimations within the Project Corridor	25
LIST	OF FIGURES	
Figure	1-1: FHWA/VDOT Preferred Alternative and Draft SEIS Build Alternatives	6
_	7-1: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 SB On/Off Ramps	
	g and No Build Alternative	
	7-2: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 EB and WB On	
	for Existing, No Build, and FHWA/VDOT Preferred Alternatives	
•	7-3: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 SB On/Off Ramps	
	/VDOT Preferred Alternative	
	7-4: National MSAT Emission Trends 1999-2050 for Vehicles Operating on Roadways Using El	
M()VE	S 2010b Model	24

1.0 INTRODUCTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA) and the United States Army Corps of Engineers (USACE) as joint lead federal agencies, has evaluated options for highway transportation improvements along the existing U.S. Route 460 (Route 460) corridor between Interstate 295 (I-295) in Prince George County and Holland Road (Route 58) in the City of Suffolk, Virginia.

In September 2014, the Draft Supplemental Environmental Impact Statement (SEIS) was issued to analyze five Build Alternatives and a No Build Alternative. Following the publication of the Draft SEIS, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts, including potential Council of Environmental Quality (CEQ) referral, and the cost opinions that had been developed. However, in addition to the Draft SEIS supporting the ability to select one of the five alternatives studied or the No Build Alternative, it also supported combining sections of those alternatives, including the No Build Alternative, to form an alternative not individually evaluated as a standalone alternative in the Draft SEIS.

As a result, VDOT carefully reconsidered each of the Draft SEIS alternatives – in whole, in parts, and in hybrid combination with one another – in order to identify a single alternative that would sufficiently address the identified project Purpose and Need, while minimizing environmental impacts and providing a cost effective project. VDOT, in close coordination with FHWA, developed a Preferred Alternative that would consist of a combination of alternatives evaluated in the Draft SEIS, including the No Build Alternative and Build Alternatives 4, 2N, 3, and 1 (from west to east). This FHWA/VDOT Preferred Alternative consists of implementing the No Build Alternative between I-295 and one mile west of Zuni, upgrading the existing Route 460 between one mile west of Zuni and two miles west of Windsor, and constructing a new four-lane divided highway from west of Windsor to a new Route 460/Route 58 interchange in Suffolk.

In February 2015 the Commonwealth Transportation Board (CTB) approved the location for the Route 460 corridor improvements, consistent with the FHWA/VDOT Preferred Alternative. Additionally, the USACE stated in January 2015¹ that it did not find reason to disagree with the assessment that FHWA/VDOT's Preferred Alternative appears to be the Least Environmentally Damaging Practicable Alternative (LEDPA), noting that the USACE comments do not constitute a final LEDPA determination or indication of a permit decision (Note: the Preferred Alternative identified in tables and figures throughout the Final SEIS and Technical Reports refers to the FHWA/VDOT Preferred Alternative).

Prepared in accordance with the implementing regulations of the National Environmental Policy Act (NEPA) at 23 CFR §771.130 and 40 CFR §1502.9(c), the Final SEIS addresses public and agency comments received on the September 2014 Draft SEIS, documents the FHWA and VDOT identified Preferred Alternative and the updated analysis associated with the FHWA/VDOT Preferred Alternative, and documents the action of the CTB.

¹ Olsen, Colonel Paul B. Letter to Aubrey Lane, Jr. 9 Jan. 2015. Norfolk, Virginia.

1.1 AIR QUALITY ANALYSIS

The purpose of this Supplemental Air Quality Analysis Technical Report is to identify and analyze the air quality impacts associated with the Preferred Alternative and to document the project's compliance with the Clean Air Act (CAA). This Technical Report includes a quantitative carbon monoxide (CO) analysis and a qualitative Mobile Source Air Toxics (MSAT) analysis and satisfies all applicable federal air quality requirements.

1.2 BACKGROUND

In May 2005, FHWA published a Draft Environmental Impact Statement (DEIS) for the Route 460 Location Study that evaluated three candidate build alternatives (CBAs) as well as the No Build Alternative and Transportation System Management (TSM) Alternative. Following the publication of the 2005 DEIS, VDOT held two public hearings presenting the technical findings of the draft analysis. In November 2005, the CTB selected the new location alternative south of existing Route 460, with an alignment shift in Isle of Wight County to reduce residential and wetland impacts (referred to as Modified CBA 1) as the preferred alternative. A Final Environmental Impact Statement (FEIS) was prepared that analyzed the environmental consequences of the preferred alternative in greater detail and was approved by FHWA in June 2008. FHWA issued a Record of Decision (ROD) in September 2008 selecting Modified CBA 1 to address the identified Purpose and Need. In November 2012, FHWA completed a NEPA Re-evaluation of the FEIS and in particular, Modified CBA 1, giving consideration to funding the project through the implementation of tolls. In reviewing the information presented in the 2008 FEIS and the 2012 NEPA Re-evaluation, the USACE indicated that the Commonwealth's preferred alternative did not appear to be the LEDPA when compared to improving the existing road. Further development of additional information and analyses of the Commonwealth's preferred alternative resulted in an increase in the acreage of wetlands identified in the Modified CBA 1 corridor compared to the acreage of wetlands presented in the 2008 FEIS. In 2013, FHWA and USACE determined that the preparation of a SEIS would be necessary in order to analyze new information with a bearing on the environmental impacts, particularly aquatic resource impacts. The SEIS also was determined to be necessary in order for the USACE to fulfill its statutory obligations under NEPA and as part of its decision making process to issue or deny authorization for impacts associated with the Route 460 corridor improvements.

The Draft SEIS was published in September 2014 and presented at three Location Public Hearings that took place in October 2014.

The Draft SEIS provided detailed analysis of five Build Alternatives (Alternatives 1-5) that met the Purpose and Need, including two alternatives on new alignment (Alternatives 1 and 3), one alternative with improvements to existing Route 460 (Alternative 4), alternatives that included a combination of new location alignment (with bypasses of the towns) with varying improvements to existing Route 460 between the towns (Alternatives 2N/S and 5N/S), and the No Build Alternative. The No Build Alternative included all planned and programmed transportation improvements in the study area that had been approved and adopted for implementation by 2040.

Following the publication of the Draft SEIS, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts including potential CEQ referral, and the cost opinions that had been developed. In order to identify a single alternative that was less impactful, as well as less costly, while sufficiently addressing the Purpose and Need, VDOT explored a combination of segments from the Draft SEIS alternatives in various configurations to develop hybrid alternatives. The goal of the hybrid development was to arrive at a recommendation for a preferred alternative that could be considered the LEDPA while sufficiently addressing the project's Purpose and Need and providing a cost effective solution.

In January 2015 VDOT, in close coordination with FHWA reconsidered the alternatives studied in the Draft SEIS and developed a 52-mile FHWA/VDOT Preferred Alternative, which included the No Build Alternative over most of its length (36 miles), with portions of four alternatives from the Draft SEIS (4, 2N, 3, and 1) for 16 miles. Since the identification and approval of the location of the FHWA/VDOT Preferred Alternative, further refinements were applied in order to avoid and minimize impacts to the greatest extent practicable. The FHWA/VDOT Preferred Alternative, including these further refinements, has been carried forward for detailed evaluation in the Final SEIS.

1.3 PURPOSE AND NEED

The purpose of the improvements to the Route 460 corridor is to construct a facility that is consistent with the functional classification of the corridor, sufficiently addresses safety, mobility and evacuation needs, and sufficiently accommodates freight traffic along the Route 460 corridor between Petersburg and Suffolk, Virginia.

The following needs have been identified for the project:

- Address roadway deficiencies: Route 460 is based on outdated geometric standards.
- Improve safety: Fatality rates for Route 460 are higher than other comparable rural roadways in Virginia.
- Accommodate increasing freight shipments: Truck percentages for Route 460 are higher than
 national averages for rural roads with a similar functional classification. Truck volumes are also
 forecast to grow due to expansions at the Port of Virginia.
- Reduce Travel Delay: Future traffic volumes will result in increased travel delays on Route 460 due to capacity limitations at traffic signals and due to the current design deficiencies.
- Provide adequate emergency evacuation capability: Route 460 is a designated hurricane evacuation
 route for Southside Hampton Roads communities, yet during recent events, the road was closed
 due to effects caused by these storms.
- Improve strategic military connectivity: Route 460 is a designated part of the Strategic Highway Network (STRAHNET) by the Department of Defense (DOD) and FHWA.
- Support local economic development plans: In addition to statewide and regional economic
 development needs, jurisdictions along the Route 460 study area have identified economic
 development priorities related to transportation improvements.

Through the evaluation of hybrid alternatives, which is detailed in the *Supplemental Alternatives Technical Report* (VDOT, 2016e), the following were identified as key improvements necessary for addressing the Purpose and Need, even if these improvements involved a hybrid alternative less than the full length of the Route 460 corridor.

- Improvements are needed along Route 460 at the Blackwater River to address longstanding flooding issues associated with safety and evacuation concerns and roadway deficiency.
- Improvements are needed at Route 58/Route 460 to provide efficient traffic movements to decrease travel time, facilitate increased freight mobility, and better accommodate emergency evacuation.
- Improvements to the eastern portion of the corridor to improve safety, as this area has the largest number of conflict points compared to the rest of the corridor; enhancements to travel time, freight mobility, and evacuation from the coastal areas would be better realized with improvements to the eastern portion of the corridor.

Based on the identification of these key components necessary for addressing the Purpose and Need, geographic limits for the hybrid alternative were refined within the eastern portion of the study corridor, where these key project components were focused and the elements of need had been demonstrated in the Draft SEIS as more pronounced. In developing hybrids, it also was important to consider opportunities to minimize environmental impacts, such as displacements and aquatic resources, and costs. Following a detailed evaluation of hybrid alternatives that focused on the eastern portion of the study corridor, FHWA/VDOT Preferred Alternative was ultimately identified as the most effective improvement option for the 16 miles for which the improvements were considered; it best addresses the project's Purpose and Need, while balancing cost, displacements, and wetlands.

1.4 FINAL SEIS ALTERNATIVES

Two alternatives are included in the Final SEIS – the FHWA/VDOT Preferred Alternative and the No Build Alternative. Following is a description of each alternative.

1.4.1 No Build Alternative

The No Build Alternative has been included to serve as a baseline for comparison of future conditions and impacts. The No Build Alternative includes all planned and programmed transportation improvements within the study area that have been approved and adopted for implementation by 2040, as identified in the VDOT Six Year Improvement Program (SYIP). These planned and programmed improvements would be developed and implemented independent of the implementation of the FHWA/VDOT Preferred Alternative. The No Build projects within the study area and projects that have the potential to affect capacity within the study area are listed in **Table 1-1**.

VDOT UPC / Locality **MPO ID** Description Construction of added left turn lane on westbound Route 460 at Enterprise 100499 Drive (Route 657). Construction of added left turn lanes on northbound Bull Hill Road (Route 630) Prince 82849 onto Route 460 in Prince George County. George Construction of right turn lanes on Courthouse Road (Route 106) at its 105110 intersection with Prince George Drive (Route 616). 104847 Construction of added left turn lane on Route 156. Improvements to Route 627 by widening, improving the drainage, and 107529 Surry straightening the roadway. N/A No projects listed. Sussex Southampton N/ANo projects listed. Construction of added left and right turn lanes on Courthouse Highway (Route 58297 258) at its intersection with Scotts Factory Road (Route 620). Isle of Wight Construction of a right turn lane on Turner Drive (Route 644) at the intersection 103021 with Benns Church Boulevard (Route 10/32). Improvements to drainage and stormwater management facilities along Pruden 104333 Boulevard (Route 460). Intelligent transportation system (ITS) improvements to 11.6 miles of the 102994 Suffolk Bypass (Route 58) from the City of Chesapeake to Holland Road. Reconstruction with added capacity on Route 58/Holland Road between the 100937 Suffolk Route 58/13/32 bypass to just west of Manning Bridge Road. Intersection improvements to Suffolk Bypass Off-Ramp at Godwin Boulevard. 102998 Construction of second exclusive right-turn lane and traffic signal improvements. Improvements to the intersection of Godwin Boulevard (Route 10) and Kings 104332 Highway (Route 125).

Table 1-1: No Build Projects within the Route 460 Study Area Jurisdictions

Source: Virginia Department of Transportation FY 2016 Final SYIP; Hampton Roads 2040 Long Range Transportation Plan: Committed and Candidate Transportation Projects, September 2014.

1.4.2 FHWA/VDOT Preferred Alternative

The FHWA/VDOT Preferred Alternative is a 52-mile corridor between I-295 in Prince George County and Route 58 in Suffolk. **Figure 1-1** illustrates the FHWA/VDOT Preferred Alternative compared to the Build Alternatives from the Draft SEIS. Following is a description of the FHWA/VDOT Preferred Alternative, from west to east:

- from I-295 to approximately one mile west of Zuni the No Build Alternative would be implemented (approximately 36 miles);
- from approximately one mile west of Zuni to two miles west of Windsor the existing US 460 would be upgraded to a four-lane divided highway and include a new bridge across the Blackwater River to eliminate long standing flooding problems (approximately 4 miles);
- from approximately two miles west of Windsor to the US 460/58 interchange in Suffolk, a new four-lane divided highway would be constructed, running north around Windsor, then east of Windsor running south of the existing US 460 (approximately 12 miles).

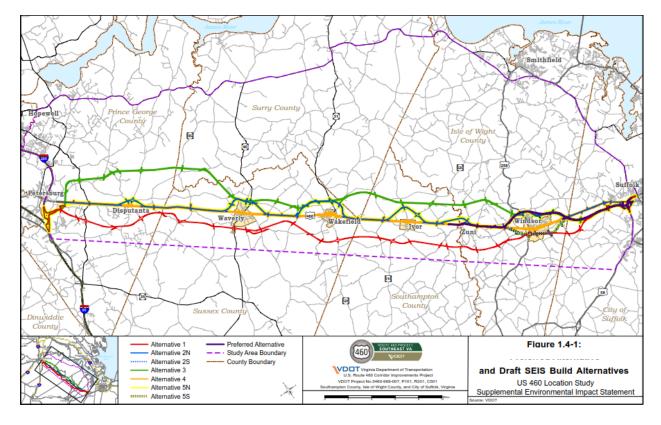


Figure 1-1: FHWA/VDOT Preferred Alternative and Draft SEIS Build Alternatives

2.0 SUMMARY

Federal funding is involved with the Project and federal approvals are required, therefore, compliance with NEPA and the CAA is required. NEPA requires consideration of whether the proposed action will have an adverse effect on air quality in the project area. To determine this, a quantitative CO analysis and a qualitative MSAT Analysis have been prepared. The CAA requires a transportation air quality conformity demonstration to any State Implementation Plan (SIP) for applicable U.S. Environmental Protection Agency (EPA) criteria pollutants in non-attainment or maintenance areas.

An air quality impact assessment of peak CO concentrations was conducted because it is required for any project for which an Environmental Impact Statement (EIS) is being prepared per the 2009 VDOT and FHWA Project-Level Carbon Monoxide Air Quality Studies Agreement (hereinafter "CO Agreement"). The worst-case CO ground level impacts were estimated at receptor locations in close proximity to the worst-case intersections and interchanges in the project corridor based on Level of Service (LOS), traffic volumes, public access, and reasonableness. The worst-case ground level CO impacts were found to remain well below the CO National Ambient Air Quality Standards (NAAQS) at all modeled receptor locations.

The Project is located in the Counties of Prince George, Sussex, Southampton, Surry, Isle of Wight and City of Suffolk; all areas currently designated as attainment for all of the NAAQS, therefore transportation conformity requirements do not currently apply for this Project.

The analysis also evaluated potential impacts from MSATs in the study area. Since the FHWA/VDOT Preferred Alternative will not add significant capacity to any of the existing and/or proposed new roadway networks where design year traffic is projected to be 140,000 to 150,000 Annual Average Daily Traffic

(AADT) or greater, the FHWA/VDOT Preferred Alternative is best characterized as a project with "Low Potential MSAT Effects" under the 2012 FHWA interim guidance update document. For the FHWA/VDOT Preferred Alternative in the design year, there could be higher MSAT emissions in some locations within the study area including the eastern termini, Route 460 mainline, and new alignment locations relative to the No Build Alternative due to higher vehicle miles traveled (VMT), and there could also be increases in MSAT levels in a few localized areas where VMT is projected to increase compared to the No Build Alternative. However, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today within the project corridor.

Emissions produced during the construction of the FHWA/VDOT Preferred Alternative will be short-term or temporary in nature. In order to mitigate these emissions, construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications require compliance with all applicable local, state, and federal air quality regulations.

3.0 TRAFFIC SUMMARY

Traffic forecasts for the No Build and FHWA/VDOT Preferred Alternatives were developed for the Existing (2013), Interim Year Build (2021) and Design Year Build (2040) conditions. For the air quality analysis, the relevant traffic components utilized from the traffic study were the level of service (LOS), average daily traffic (ADT), peak-hourly ADT, congested speeds, turning movements, roadway grade and signal timing data. Since the roadway improvements associated with the FHWA/VDOT Preferred Alternative occur in the eastern portion of the project corridor, the traffic study focused on this area and included an evaluation of the eastern terminus, Route 460 mainline, and the new location alignment.

4.0 EXISTING CONDITIONS

The Project is located in the Counties of Prince George, Sussex, Southampton, Surry, Isle of Wight and City of Suffolk. The EPA Green Book² showing non-attainment, maintenance, and attainment areas was reviewed to characterize the existing air quality conditions of the Project corridor. The analysis focused on regulated air pollutants contained in the NAAQS; including sulfur dioxide (SO₂), CO, nitrogen dioxide (NO₂), ozone (O₃), and particulate matter (PM₁₀ and PM_{2.5}).

A review of the EPA Green Book show that the entire project corridor is located in an area designated as being in attainment for all of the NAAQS.

5.0 METEOROLOGY CLIMATE

The area where the FHWA/VDOT Preferred Alternative is located is best categorized as a humid subtropical climate that averages approximately 46 inches of precipitation per year. The average daily high temperature in July is 87 degrees Fahrenheit while the average daily low temperature in January is 32 degrees Fahrenheit.

_

² EPA Greenbook https://www3.epa.gov/airquality/greenbook/faq.html

6.0 REGULATORY STANDARDS

The air quality analysis has been prepared in accordance with NEPA and the CAA. The following sections summarize federal air quality requirements.

6.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

Pursuant to the 1970 CAA, the EPA established NAAQS for major pollutants known as "criteria pollutants." Currently, the EPA regulates six criteria pollutants: O₃, CO, NO₂, SO₂, particulate matter, and lead (Pb). Particulate matter (PM) is divided into two particle size categories: particles with a diameter less than 10 micrometers (PM₁₀) and those with a diameter of less than 2.5 micrometers (PM_{2.5}). **Table 6-1** shows the primary and secondary NAAQS for the criteria pollutants. The NAAQS are two-tiered. The first tier (primary) is intended to protect public health; the second tier (secondary) is intended to protect public welfare and prevent further degradation of the environment.

Section 176(c) of the CAA requires Federal agencies to assure that all of their actions conform to applicable implementation plans for achieving and maintaining the NAAQS. Federal actions must not cause or contribute to any new violation of any standard, increase the frequency or severity of any existing violation, or delay timely attainment of any standard.

The standards in **Table 6-1** apply to the concentration of a pollutant in outdoor ambient air. If the air quality in a geographic area is equal to or is better than the national standard, EPA will typically designate the region as an attainment area. Areas where air quality does not meet the national standards are typically designated as non-attainment areas. Once the air quality in a non-attainment area improves to the point where it meets the standards and the additional redesignation requirements in the CAA [Section 107(d)(3)(E)], EPA may redesignate the area as an attainment/maintenance area, which are typically referred to as "maintenance areas."

The Clean Air Act Amendments (CAAA) of 1990 requires EPA to designate the status of all areas as being in or out of compliance with the NAAQS. The CAAA further defines non-attainment areas for ozone based on the severity of the violation as marginal, moderate, serious, severe, and extreme. The project is located in an area that is currently designated as attainment for all of the NAAQS.

6.2 MOBILE SOURCE AIR TOXICS

In December of 2012, FHWA issued the Interim Guidance Update on MSAT in NEPA³. The update reflects the recent implementation of the EPA Motor Vehicle Emissions Simulator (MOVES) emission model for estimating MSAT emissions from mobiles sources along with updating the scientific research in the MSAT arena.

The EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer drivers from their 1999 National Air Toxics Assessment (NATA). The seven compounds identified were acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter (POM).

³ Interim Guidance Update on Mobile Source Air Toxics Analysis in NEPA (December 2012).

Primary Standards [1,2] **Pollutant Averaging Time** Secondary Standards [1,3] 8- hour 9 ppm (10 mg/m^3) None CO 1-hour $35 \text{ ppm } (40 \text{ mg/m}^3)$ None Lead [4] Rolling 3-Month Average^[5] $0.15 \, \mu g/m^3$ Same as Primary Annual Arithmetic Mean $0.053 \text{ ppm} (100 \,\mu\text{g/m}^3)$ Same as Primary NO_2 1-hour $0.100 \text{ ppm}^{[6]}$ None Annual Arithmetic Mean None None PM_{10} 24-hour $150 \, \mu g/m^3$ Same as Primary Annual Arithmetic Mean $12 \mu g/m^{3,9}$ $15 \mu g/m^3$ $PM_{2.5}$ 24-hour $35 \, \mu g/m^3$ Same as Primary 8-hour (2015 standard)[10] 0.070 ppm Same as Primary Same as Primary 8-hour (2008 standard) 0.075 ppm O_3 8-hour (1997 standard) 0.08 ppm Same as Primary $0.12 \text{ ppm}^{[7]}$ Same as Primary 1-hour 75 ppb^[8] 1-hour None SO_2 3-hour None 0.5 ppm

Table 6-1: National Ambient Air Quality Standards

Notes:

- 1. National standards (other than ozone, particulate matter, and those based on annual averages) are not to be exceeded more than once per year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over three years, is equal to or is less than the standard. For PM_{10} , the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m^3 is equal to or is less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or are less than the standard.
- 2. Primary Standards: Levels necessary to protect public health with an adequate margin of safety.
- 3. Secondary Standards: Levels necessary to protect the public from any known or anticipated adverse effects.
- 4. Lead is categorized as a "toxic air contaminant" with no threshold exposure level for adverse health effects determined.
- 5. National lead standard, rolling three-month average: final rule signed October 15, 2008.
- 6. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).
- 7. EPA revoked the 1-hour ozone standard in all areas; however, some areas have continuing obligations under that standard.
- 8. Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
- 9. EPA updated the NAAQS for PM_{2.5} to strengthen the primary annual standard to 12 ug/m³.
- 10. EPA updated the NAAQS for Ozone to strengthen the primary 8-hour standard to 0.07 ppm on October 1, 2015. An area will meet the standard if the fourth-highest maximum daily 8-hour ozone concentration per year, averaged over three years is equal to or less than 70 ppb.

While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

The FHWA guidance developed a tiered approach for assessing MSATs in NEPA documents and identified three levels of analysis. The three levels identified were for projects with no meaningful MSAT effects, low potential MSAT effects, and high potential MSAT effects. The FHWA guidance defines the levels of analysis for each type of MSAT effect:

- No analysis for projects with no potential for meaningful MSAT effects;
- A qualitative analysis for projects with low potential MSAT effects; and
- A quantitative analysis for projects with high potential MSAT effects.

The FHWA/VDOT Preferred Alternative was evaluated against each threshold criteria in order to determine the type of MSAT analysis required to satisfy NEPA.

7.0 PROJECT ASSESSMENT

An air quality project level assessment was conducted for CO, PM and MSATs. The methodologies and assumptions for addressing the type of analysis for each pollutant is discussed below and is consistent with all FHWA and EPA regulations and guidance, as well as the VDOT Consultant Guide on Air Quality Project-Level Analysis (May, 2009)⁴.

7.1 CARBON MONOXIDE (CO) ANALYSIS

On February 27, 2009, the FHWA and VDOT finalized an agreement for addressing project-level CO air quality analyses in NEPA documents. Under the CO Agreement, project-level air quality (hot-spot) analyses are typically conducted for CO for projects that exceed ADT and level of service thresholds specified in the CO Agreement. The CO Agreement also requires a hot-spot analysis for any project for which an EIS is being prepared.

The CO hot-spot analysis utilized the traffic assessment conducted by the design team for the 2013 Existing year, 2021 Interim year and the 2040 Design year conditions. Emissions of CO were estimated using the EPA MOVES model. Ambient concentrations at sensitive receptor locations were estimated using the EPA CAL3QHC dispersion model, and the results were added to appropriate background concentrations for comparison to the CO NAAQS to determine compliance.

7.1.1 Methodology

A microscale analysis typically examines worst-case ground-level CO impacts due to traffic flow in the immediate vicinity of a project intersection/interchange. CO is used in microscale studies to indicate roadway pollutant levels as it is the most abundant pollutant emitted by motor vehicles and can result in so-called "hot-spot" (i.e., high concentration) locations around congested intersections and interchanges. The NAAQS were developed by the EPA to protect human health against adverse health effects with an adequate margin of safety. These standards do not allow ambient CO concentrations to exceed 35 parts per million (ppm) for a 1-hour averaging period and 9 ppm for an 8-hour averaging period, more than once per year at any location. The widespread use of advanced catalytic technologies on late-model vehicles has significantly reduced the occurrences of CO hotspots in recent years. Air quality models (computer simulation programs) are used to predict worst-case CO levels for both existing and future conditions to evaluate compliance of proposed roadways with the CO NAAQS.

A microscale analysis was conducted using the EPA MOVES2010b and CAL3QHC models to estimate worst-case CO concentrations at individual receptor (i.e. receiver) locations. Peak CO concentrations resulting from the project at each location were then added to the appropriate CO background concentration to determine the worst-case CO impacts at each location. These values were then compared to the 1-hour and 8-hour CO NAAQS to determine compliance.

7.1.2 Interchanges/Intersections Studied

For the Final SEIS, anticipated peak hour and daily traffic volumes were evaluated to determine the worst-case locations chosen for analysis. **Table 7-1** provides the anticipated daily traffic volumes for the 2013 Existing, 2021 Interim Build and No Build, and 2040 Design Year Build and No Build conditions for each

⁴ Consultant Guide Air Quality Project-Level Analysis, Revision 18: VDOT Environmental Division, Air Section, May 2009.

link studied along the Route 460 mainline, new location alignment and the eastern termini including the Route 460 and Godwin Boulevard interchange.

In the entire project corridor, worst-case traffic volumes are anticipated along Route 58 north of Godwin Boulevard at 80,700 ADT for the Build 2040 condition. In addition, ADT volumes along Route 58 from Route 460 to Godwin Boulevard are expected to operate at 71,900 ADT for the Build 2040 condition. Since these two eastern terminus interchanges along Route 58 at Route 460 and at Godwin Boulevard have the highest ADT in the entire project corridor, they were considered worst-case and therefore chosen for evaluation in the CO hot-spot analysis.

An analysis of the LOS was also evaluated to confirm the worst-case intersection locations for inclusion in the CO hot-spot analysis. An evaluation of the 2021 and 2040 LOS and peak hourly traffic volumes in **Table 7-2** indicates that the eastern termini intersection of existing Route 460 at Sadler Pond Drive/Murphy's Mill Connector is the only intersection expected to operate at LOS F for the Build 2040 condition. This intersection has higher peak hourly volumes than other intersections along the mainline and was therefore chosen as the worst-case intersection for evaluation in the CO hot-spot analysis.

Also included in the CO hot-spot analysis at the Route 460 and Route 58 interchange, based on the proximity to the two worst-case interchanges identified above, are the intersections at existing Route 460 at the westbound Route 58 ramp and existing Route 460 at the eastbound ramp. Similarly, the Route 58 eastbound ramp and the Route 58 westbound ramp intersections were also included to the Route 58 and Godwin Boulevard interchange CO hot-spot analysis.

In summary, a review of the ADT in **Table 7-1** for each analysis year determined that the two worst-case interchanges with the highest ADT are expected to occur at the interchanges at Route 58 at existing Route 460 and Route 58 at Godwin Boulevard. These two interchanges are considered worst-case and were therefore included in the CO hot-spot analysis. Furthermore, based on a review of the 2021 and 2040 LOS and peak hourly traffic volumes in **Table 7-2**, along with intersection locations in proximity to the two worst-case interchanges identified above, the following five intersections were also included in the analysis:

- Existing Route 460 at Sadler Pond Drive/Murphy's Mill Connector;
- Existing Route 460 at Route 58 eastbound ramps;
- Existing Route 460 at Route 58 westbound ramps;
- Westbound Route 58 ramps at Godwin Boulevard; and
- Eastbound Route 58 ramps at Godwin Boulevard.

The traffic analysis as summarized above and referenced in **Table 7-1** and **Table 7-2** has demonstrated that the intersections/interchanges evaluated in the CO hot-spot analysis have the worst-case LOS and/or highest traffic volumes within the project corridor, and are therefore representative of the locations where peak CO concentrations would be expected to occur. It is assumed that if these intersections/interchanges show peak CO concentrations below the CO NAAQS, then all other locations in the project corridor will also remain below the CO NAAQS. **Appendix A** contains the traffic analysis results for each condition used in the air quality analysis.

Table 7-1: Existing, Interim and Design Year Average Daily Traffic (ADT)

Link	Existing (2013)	Interim No Build (2021)	Interim Build (2021)	Design No Build (2040)	Design Build (2040)
Description	ADT	ADT	ADT	ADT	ADT
Eastern Terminus (East of 634)					
US 58 from US 460 to Godwin Blvd - EB	40.000	F0 000	F7 700	00.000	74.000
US 58 from US 460 to Godwin Blvd - WB	48,200	52,600	57,700	62,200	71,900
US 58 north of Godwin Blvd - EB	F0 000	04.000	07.500	70,000	00.700
US 58 north of Godwin Blvd - WB	59,800	64,200	67,500	76,000	80,700
US 58 south of US 460 - EB	40,000	40.000	44.000	40.400	F4 F00
US 58 south of US 460 - WB	40,000	42,800	41,900	49,400	51,500
US 460 from Route 634 to existing General Early Dr	20,100	22,400	9,500	30,600	15,400
US 460 from existing General Early Dr to Northfield Dr	20,100	22,400	9,500	30,600	15,400
US 460 from Northfield Dr to US 58	22,400	25,600	12,500	34,900	19,300
US 460 from US 58 to Sadler Pond Dr	11,400	12,800	12,900	18,800	19,700
US 460 from Sadler Pond Dr to Meade Pkwy	11,100	12,500	12,600	18,600	19,200
Ramp from US 58 EB to US 460	2,800	3,200	2,000	4,300	3,000
Ramp from US 58 EB to New US 460 WB (Ramp D)			1,400		2,300
Ramp from US 58 WB to Bus US 460 (Ramp H)	7,000	8,100	2,700	10,700	3,500
Ramp from US 58 WB to New US 460 WB (Ramp E)			8,600		12,000
Ramp from Bus US 460 EB to US 58 EB	6,200	7,300	2,700	9,800	3,500
Ramp from Bus US 460 to US 58 WB	2,900	3,200	2,000	4,300	3,000
Ramp from Bus US 460 WB to US 58 EB	800	800		900	
Ramp from New US 460 EB to US 58 EB (Ramp B)			8,600		12,000
Ramp from New US 460 EB to US 58 WB (Ramp C)			1,400		2,300
New US 460 from General Early Dr ramps to US 58 ramps			20,000		28,600
Existing General Early Dr from US 460 to New US 460	100	200		1,600	
General Early Dr from New US 460 to Bus US 460			3,000		5,300
General Early Dr from New US 460 to Murphys Mill Rd			2,100		3,500
Ramp from General Early Dr to New US 460 WB (Ramp F)			800		1,500
Ramp from New US 460 EB to General Early Dr (Ramp A)			800		1,500
Godwin Blvd from US 58 to Bus US 460	20,500	25,300	24,020	37,300	32,360
Godwin Blvd north of US 58	37,020	43,980	43,160	59,240	56,340
Ramp from US 58 WB to Godwin Blvd (Ramp B)	10,000	11,000	10,200	14,000	11,500
Ramp from Godwin Blvd to US 58 WB (Ramp A)	4,300	5,200	5,300	7,100	7,100
Ramp from US 58 EB to Godwin Blvd (Ramp D)	4,000	5,200	5,300	7,100	7,100
Ramp from Godwin Blvd SB to US 58 EB (Ramp E)	7,000	7,900	7,600	10,000	8,700
Ramp from Godwin Blvd NB to US 58 EB (Ramp C)	2,800	3,100	2,600	4,000	2,800
Northfield Dr north of US 460	1,700	1,900	1,900	2,200	2,200
Murphys Mill Connector from Bus US 460 to Murphys Mill Rd			1,500		2,000
Sadler Pond Dr north of Bus US 460	1,400	1,500	1,500	1,600	1,600

Note: 1. The yellow highlighted link denotes the highest ADT predicted within the study area for each condition.

Supplemental Air Quality Analysis Technical Report

Table 7-1: Existing, Interim and Design Year Average Daily Traffic (ADT) (cont.)

Link	Existing (2013)	Interim No Build (2021)	Interim Build (2021)	Design No Build (2040)	Design Build (2040)
Description	ADT	ADT	ADT	ADT	ADT
Intersections Existing 460 Mainline					
Route 460 from Route 616 eastbound and westbound (west of intersection)	9,000	10,400	11,900	17,000	19,600
Route 460 from Route 616 eastbound and westbound (east of intersection)	9,300	10,800	12,400	17,300	20,600
Route 616 North and southbound from Route 460	2,800	2,600	2,600	2,400	2,400
Route 460 from Routh 639 eastbound and westbound (east of intersection)	9,600	11,500	13,300	18,400	22,400
Route 460 from Routh 639 eastbound and westbound (west of intersection)	9,800	11,700	14,600	18,700	23,900
Routh 639 north and southbound from Route 460	300	400	2,200	600	2,700
Existing 460 east and westbound (west of intersection)			14,600		23,900
New 460 east and westbound (east of intersection)			13,500		21,600
Existing 460 north and southbound from new 460 and existing 460			2,700		4,600
		***************************************			***************************************
Existing 460 from Route 258 eastbound and westbound (west of intersection)	10,700	13,000	3,600	20,600	5,900
Existing 460 from Route 258 eastbound and westbound (east of intersection)	14,200	16,300	9,100	24,000	12,600
Route 258 from Existing 460 north and southbound (north of intersection)	5,800	6,700	8,400	8,200	10,600
Route 258 from Existing 460 north and southbound (south of intersection)	5,000	5,600	8,300	7,100	10,100
Existing 460 from 603/610 eastbound and westbount (west of intersection)	14,600	16,900	9,200	24,600	12,700
Existing 460 from 603/610 eastbound and westbount (east of intersection)	15,100	17,400	9,100	25,500	12,800
Route 610 from 460/603/610 northbound and southbound (north of intersection)	1,700	2,400	2,100	4,600	3,600
Route 610 from 460/603/610 northbound and southbound (south of intersection)	1,100	1,800	1,500	3,500	2,500
Route 603 from 460/603/610 northbound and southbound (north of intersection)	2,800	3,800	3,600	6,600	6,200
Route 603 from 460/603/610 northbound and southbound (norht of intersection)	2,400	3,100	2,800	5,900	3,700
New Route 460 at Existing 460 eastbound and westbount (east of intersection)			13,600		21,600
New Route 460 at Existing 460 eastbound and westbount (west of intersection)	•		21,600		31,600
EB Offramp new 460 eastbound			600		1,200
NB Onramp new 460 eastbound	•		4,600		6,200
Existing 460 at new 460 northbound and southbound (south of intersection)			10,300		15,100
Existing 460 at new 460 northbound and southbound (north of intersection)			4,100		8,900
SB Offramp new 460 westbound	•		4,600		6,200
SB Onramp new 460 westbound			600		1,200

Route 460 from Route 634 eastbound and westbound (east of intersection)	16,900	19,300	6,100	26,800	10,200
Route 460 from Route 634 eastbound and westbound (west of intersection)	17,100	19,700	8,000	27,200	13,400
Route 634 from Route 460 northbound and southbound (south of intersection)	4,400	5,900	7,000	11,500	13,100
Route 634 from Route 460 northbound and southbound (north of intersection)	2,600	3,100	3,100	4,400	4,800

Note:1. The yellow highlighted link denotes the highest ADT predicted within the study area each condition

June 2016
Supplemental Air Quality Analysis Technical Report

Table 7-2: Existing, Interim and Design Year Projected LOS and Peak Hourly Volumes

	Existing No Build					Build							
Intersection	2013 2021 20		40		2021		2040						
Intersection	Facility Type	AM	PM	Facility Type	AM	PM	AM	PM	Facility Type	AM	PM	AM	PM
		Peak	Peak		Peak	Peak	Peak	Peak		Peak	Peak	Peak	Peak
	Easte	ern Te	rminu	us Intersec	tions								
Existing Route 460 at Relocated General Early Dr / Northfield Dr	Signalized	Α	Α	Signalized	Α	Α	Α	Α	Signalized	В	В	В	С
	Peak Hourly Volumes	1,770	1,900		1,980	2,180	2,550	2,990	J	1,900	2,320	2,840	3,340
Existing Route 460 at WB Route 58 Ramps	Unsignalized (4)	С	Е	Signalized (4)	Α	Α	Α	Α	Signalized (4)	Α	Α	Α	Α
	Peak Hourly Volumes	3,600	3,860		4,050	4,390	5,280	6,100		2,310	2,510	3,220	3,760
Existing Route 460 at EB Route 58 Ramps	Signalized	В	Α	Signalized	С	В	С	С	Signalized	В	Α	В	Α
	Peak Hourly Volumes	1,980	2,040		2,200	2,320	2,930	3,420		1,760	1,590	2,590	2,470
Existing Route 460 at Sadler Pond Dr / Murphy's Mill Connector	Unsignalized	В	В	Unsignalized	В	С	С	D	Unsignalized (5)	С	С	F	F
		1,210	1,620	_	1,370	1,840	2,010	2,810		1,430	1,790	2,870	3,330
General Early Dr at WB New Route 460									Unsignalized	Α	Α	Α	Α
·	Peak Hourly Volumes									210	310	420	510
General Early Dr at EB New Route 460									Unsignalized	Α	Α	В	В
·	Peak Hourly Volumes									760	1,000	1,440	1,600
WB Route 58 ramps at Godwin Blvd	Signalized	D	D	Signalized	С	С	D	D	Signalized	С	С	С	D
	Peak Hourly Volumes	5,830	6,520	<u> </u>	6,800	7,810	8,920	10,580		6,740	7,730	8,030	9,940
EB Route 58 ramps at Godwin Blvd	Signalized	В	В	Signalized	В	В	D	С	Signalized	В	В	С	С
	Peak Hourly Volumes	3,210	3,710		3,930	4,700	5,620	6,720		3,920	4,580	4,970	6,250
	R	oute	460 Ir	tersection	S						•	•	
Route 460 at Route 616/Main Street	Signalized	В	В	Signalized	Α	Α	Α	Α	Signalized	Α	Α	Α	Α
Notice 100 at Notice 010, Main Street	Peak Hourly Volumes	680	900	Signanzea	750	1,040	1,160	1,570	Signanzea	870	1,130	1,360	1,790
Route 460 at Winston Dr/ Route 639	Unsignalized	В	В	Unsignalized	В	В В	C	D	Unsignalized	В	C	C	D
nous root trinsten 21, nous oos	Peak Hourly Volumes	605	860	01101811011200	750	1,070	1,240	1,640		1,070	1,450	1,600	2,260
Existing Route 460 at New Route 460 (Green-T)							,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	_,=	Signalized	A	A	A	Α
	Peak Hourly Volumes									1,110	1,490	1,680	2,330
Existing Route 460 at Route 258/ Prince Blvd	Signalized	D	D	Signalized	D	D	D	Е	Signalized	D	D	D	E
0	Peak Hourly Volumes	1,200	1,600		1,410	1,850	2,010	2,660		1,100	1,310	1,600	1,880
Existing Route 460 at Routes 610/603/1810	Signalized	E	D	Signalized	D	D	F	F	Signalized	C	D	E	E
, , , , , , , , , , , , , , , , , , ,	Peak Hourly Volumes	1,395	1,715		1,760	2,100	2,660	3,220		1,170	1,310	1,840	2,050
Existing Route 460 at EB New Route 460 ramps									Signalized	Α	В	В	В
	Peak Hourly Volumes									780	1,070	1,230	1,620
Existing Route 460 at WB New Route 460 ramps	,								Signalized	В	C	В	C
F-	Peak Hourly Volumes									530	810	900	1,340
Route 460 at Route 634/Kings Fork Rd	Signalized	С	С	Signalized	В	С	D	D	Signalized	С	В	С	C
· •	Peak Hourly Volumes		2,025	Ĭ	2,000	2,420	2,730	3,320		1,030	1,270	1,670	2,040
Notes:													
(1) Traffic analysis performed in accordance with the Highway Capacity Manual 2010 and the VDOT Traffic Analysis Tool Guidebook Version 1.1							Legend: Level of	f Service					
(2) Per the HCM 2010, the capacities of all entering and departure segments have been checked to confirm that volumes do not exceed capacity										LOS C or	better		
(3) For unsignalized intersections, the LOS reported is for the mover	nent with the worst LOS									LOS D			
(4) Intersection currently operates unsignalized but is assumed to be	-	-								LOS E			
(5) Intersection currently operates unsignalized; installation of a tra-					/					LOS F			
	Denotes intersections of	hosen fo	r CO Hot	spot analysis.									

7.1.3 MOVES Emissions Estimation

CO vehicle emission rates were estimated using the EPA MOVES model version 2010b which replaced the MOBILE6.2 emission model. EPA has released a more recent version of MOVES (MOVES2014) in July of 2014; however, EPA allocated a two-year grace period before it is required for use in project-level analyses. Since this project is still within the EPA grace period, MOVES2010b was utilized for this study. The methodologies and assumptions used for the MOVES modeling were consistent with the EPA guidance document titled "Using MOVES in Project Level Carbon Monoxide Analyses". The vehicle and fuel data that was used in the MOVES modeling was provided by VDOT for 2013, 2021 and 2040 conditions, consistent with the latest planning assumptions representing the City of Suffolk. Specifically, fuel data along with vehicle population and age distribution input data were provided to populate the MOVES project data manager database. The source type hour fractions for each link were derived from the total source operating hours for each vehicle type and road type that were generated from a regional MOVES model run using inputs provided by VDOT. MOVES input relies on link-specific data, therefore, a link file was developed for each worst-case intersection/interchange studied for each analysis year. The link file includes road type, peak-hourly volumes, link lengths, congested speed, and roadway grade. The roadway grades for the intersections/interchanges were provided by VDOT traffic engineers based on roadway lengths and mapping survey data elevations for the existing roadways along with maximum allowable roadway grades using the VDOT Road Design Manual as worst-case assumptions for the new roadways links. Worst-case meteorological data consistent with the VDOT Consulting Guide for the City of Suffolk (i.e. Hampton Roads) was used to configure the RunSpec portion of the MOVES program. A summary of the MOVES inputs are presented in **Table 7-3**.

Parameter Assumption Scale Menu "Project" Domain Calculation Type "Inventory" Min/Max Temperature Relative Humidity Relative Humidity = 75% **Evaluation Month** January Year = (2013, 2021, 2040); AM Hour = 7AM to 8AM; Time Span PM Hour = 4PM to 5PM; Days = Weekdays Geographic Bounds Virginia, City of Suffolk Vehicles Equipment All Vehicle Types for diesel and gasoline, and CNG transit buses Link Files Roadway Specific Roadway Grade/Link Speeds Provided by VDOT/HDR Inc. (Design Engineering Firm) Provided by VDOT Fuel and I/M Inputs Vehicle Population and Age Distribution Provided by VDOT Pollutants and Process Panel CO Running and CO Crankcase Output Panel Grams and Miles Selected as Units, Population and Distance traveled

Table 7-3: Summary of MOVES Inputs

Mobile source emission factors were calculated based on actual congested speeds at which vehicles travel through the intersections/interchanges, while idle emissions are used to represent vehicles queuing. The

_

⁵ EPA, December 2010, "Using MOVES in Project Level Carbon Monoxide Analyses", EPA-420-B-10-041

MOVES runs were used to generate CO emission rates for input into the CAL3QHC dispersion model for the Existing (2013), Interim year (2021), and final Design year (2040) conditions. As an example of MOVES generated emission rates, **Table 7-4** summarizes the emission factors generated by MOVES for each year and vehicle speed for the Route 58 and Route 460 interchange and Route 58 and Godwin Blvd Interchange. A sample MOVES input and output file is provided in **Appendix B**. A complete set of MOVES input/output files can be made available upon request.

Route 58 and Route 460 Interchange	Vehicle Speed (mph)	2013 (g/mile) ¹	2021 (g/mile) ¹	2040 (g/mile) ¹
	Idle ³	29.0	9.3	4.8
	25	6.0	4.0	3.5
	35	5.2	3.2	3.1
	45	4.2	2.8	2.5
	60	5.6	3.9	3.5
Route 58 and Godwin	Vehicle Speed (mph)	2013 (g/mile) ¹	2021 (g/mile) ¹	2040 (g/mile) ¹
Blvd Interchange	Idle ³	29.0	9.3	4.8
	25	6.5	4.5	3.9
	30	6.1	4.2	3.7
	40	6.8	3.4	4.3
	45	4.7	3.2	2.8
	60	4.1	2.8	2.4

Table 7-4: Summary of MOVES CO Emission Factors

Notes:

- 1. MOVES emission factors may vary for individual speeds based on average link grade.
- 2. n/a denotes vehicle speeds do not exist for this modeled Alternative.
- 3. Idle emissions are in grams per vehicle hour.

7.1.4 CAL3QHC Dispersion Model

The latest version of the CAL3QHC model (04244)⁶ was used to predict worst-case 1-hour CO concentrations from queue and free-flow links using the FHWA CAL3Interface⁷. The CAL3Interface is a software package developed by FHWA that incorporates the EPA CAL3QHC dispersion model. The CAL3QHC model incorporated various worst-case default parameters per EPA guidance. The peak AM and PM 1-hour CO concentrations from CAL3QHC were scaled by a factor of 0.7⁸ to estimate 8-hour CO concentrations. Traffic signal timing data provided by Whitman, Requardt & Associates was used for signalized intersections. Travel speeds were estimated based on field observations, the traffic analysis, and queuing at the intersections. A summary of inputs used in the CAL3Interface model are shown in **Table 7-5.**

⁶ "User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections", EPA-454/R-92-006 (Revised), EPA, September 1995.

⁷ See CAL3Interface – A Graphical User Interface for the CALINE3 and CAL3QHC Highway Air Quality Models", Michael Claggett, Ph.D., FHWA Resource Center, 2006.

⁸ EPA guidance for estimating 8-hour concentrations from 1-hour concentrations.

DescriptionValueSurface Roughness Coefficient175 CentimetersBackground CO Concentrations3.6 ppm 1-hour, 2.5 ppm 8-hour (Hampton Roads)Wind Speed1.0 meter per secondStability ClassUrban DMixing Height1,000 metersWind Direction5 degree increments

Table 7-5: Summary of CAL3QHC Inputs

A sample CAL3QHC input and output file is provided in **Appendix C**. A complete set of CAL3QHC files can be made available upon request.

7.1.5 Receptors

For the modeling analysis, receptor locations were placed in the vicinity of each intersection/interchange at worst-case locations such as sidewalks, property lines, and parking lots where the public generally has access for the Existing, No Build and FHWA/VDOT Preferred Alternatives. Consistent with EPA modeling guidelines⁹, the receptors were located a minimum of three meters from the edge of the roadway and positioned at a height of 1.8 meters above the ground. **Figure 7-1** shows the receptor locations at the Route 58 and Route 460 interchange as modeled in CAL3QHC for the Existing conditions while **Figure 7-2** shows the receptor locations for the FHWA/VDOT Preferred Alternative design. **Figure 7-3** shows the receptor locations for the Route 58 and Godwin Boulevard Interchange as modeled in CAL3QHC for the Existing and FHWA/VDOT Preferred Alternative.

-

⁹ "Guidelines for Modeling Carbon Monoxide from Roadway Intersections", EPA-454/R-92-005, U.S. EPA, 1992.

Figure 7-1: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 SB On/Off Ramps for Existing and No Build Alternative

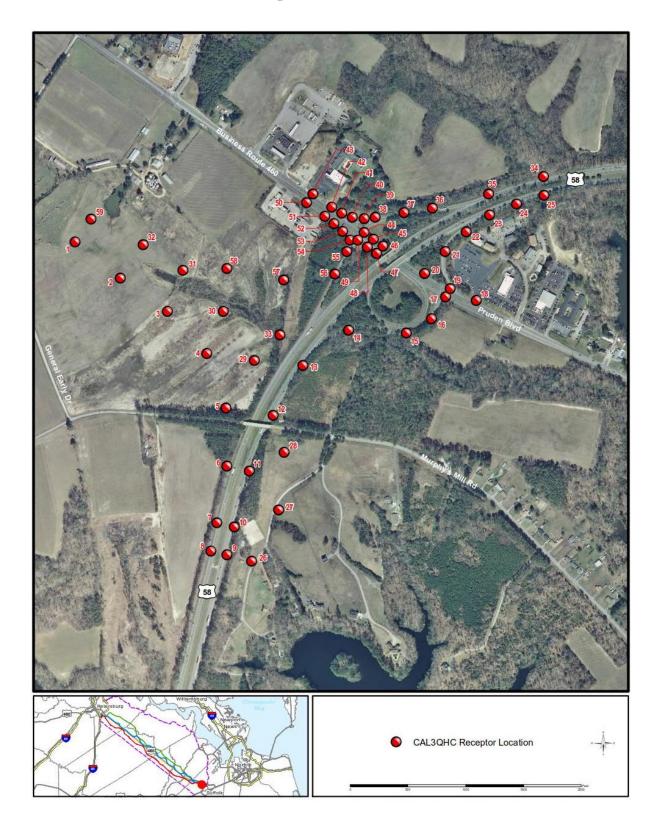
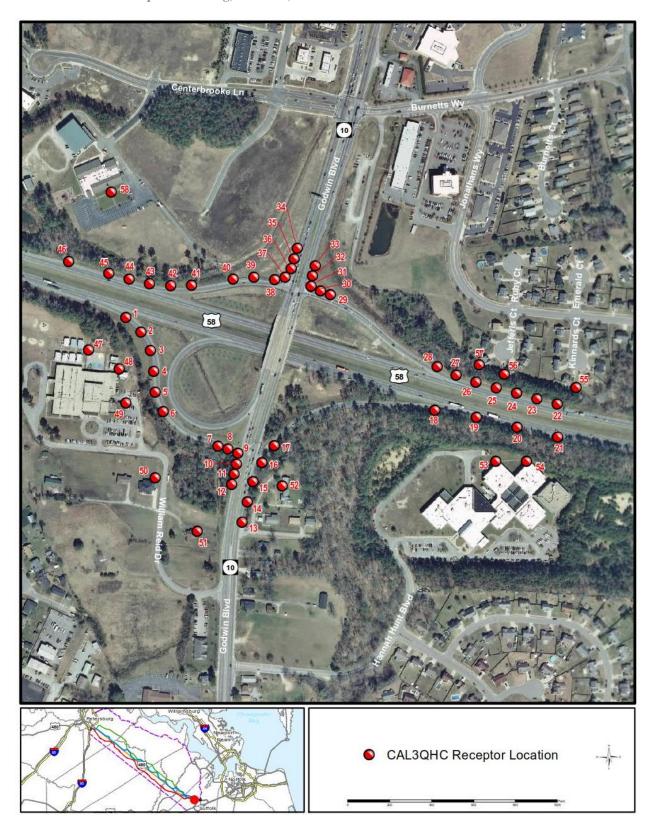


Figure 7-2: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 EB and WB On/Off Ramps for Existing, No Build, and FHWA/VDOT Preferred Alternatives



CAL3QHC Receptor Location Future Roadway Alignment

Figure 7-3: CAL3QHC Receptor Locations: Eastern Terminus Including Route 58 SB On/Off Ramps for FHWA/VDOT Preferred Alternative

7.1.6 CAL3QHC Modeling Results

The results of the 1-hour and 8-hour CO hot-spot analysis for the eastern terminus interchange/intersection locations is presented in **Table 7-6** for the Existing, Interim and Design year Build and No Build Alternatives. The table includes the overall worst-case modeled concentrations for the AM and PM peak periods, and includes the modeled receptor number in parenthesis. The concentrations in **Table 7-6** also include the appropriate 1-hour and 8-hour background concentrations of 3.6 ppm and 2.5 ppm¹⁰, respectively, for comparison to the CO NAAQS. The highest 1-hour predicted concentrations for the Existing, Interim and Design Build conditions were 4.7 ppm, 4.3 ppm and 4.3 ppm, respectively. The maximum 1-hour concentration of 4.7 ppm was predicted to occur for the 2013 Existing condition at the Route 58 and Godwin Blvd interchange, and the worst-case concentrations are predicted to be lower than the Existing concentrations for both future conditions (build/no-build). All predicted 1-hour CO concentrations are well below the 1-hour CO NAAQS of 35 ppm. A table of peak CO concentrations at all receptors at each of the worst-case interchanges / intersections for each scenario is included in **Appendix D**.

20131,2 20211,2 20401,2 **NAAQS** No Build No Build Build Build **Existing** (ppm) Intersection / **Averaging Peak** Peak Peak **Peak Peak** Peak **Peak** Peak Peak Peak Interchange Period **AM** PM **AM** PM **AM** PM AM PM **AM** PM (PPM) Eastern Terminus 4.6 4.1 4.3 4.3 4.2 4.3 4.2 4.3 4.7 4.3 Interchange-1-hour 35 (23)(36)(27)(24)(25)(25)(26)(25)(8)(24)Godwin Boulevard at Route 58 EB 3.2 2.9 3.0 3.0 2.9 3.0 2.9 3.0 3.3 3.0 and WB On/Off 9 8-hour (8)(36)(8)(27)(24)(24)(25)(25)(26)(25)ramps Intersection Eastern Terminus 4.2 4.4 4.0 4.2 4.2 4.1 4.2 4.2 4.1 4.3 Interchange- US 35 1-hour (8) (7) (7) (7) (8) (7) (8)(7) (21)(21)460 Business and Route 58 EB and WB On/Off ramps 2.9 3.1 2.8 2.9 2.9 2.9 2.9 2.9 2.9 3.0 9 8-hour and Sadler Pond (8) (21)(21)(7) (7) (7) (8)(7) (8) (7) Dr Intersections

Table 7-6: CAL3QHC Modeling Results for the Eastern Terminus Intersection/Interchange

Notes: 1. Total concentration is the sum of the modeled concentration plus background concentrations. 2. Number in parenthesis represents the modeled receptor number of maximum modeled concentration. Refer to Figures 7.1-1, 7.1-2 and 7.1-3.

The peak 1-hour values generated by CAL3QHC were scaled by a persistence factor of 0.7 to generate peak 8-hour CO concentrations, and these values were then added to the appropriate background concentration for comparison to the CO NAAQS. The highest 8-hour concentrations for the Existing, Interim, and FHWA/VDOT Preferred Alternative conditions were 3.3 ppm, 3.0 ppm and 3.0 ppm, respectively. Similar to the peak 1-hour concentrations, the maximum 8-hour CO concentrations of 3.3 ppm was predicted to occur for the 2013 Existing condition at the Route 58 and Godwin Blvd Interchange, and the worst-case concentrations are expected to be lower than the Existing conditions for both future conditions. All predicted 8-hour CO concentrations are also well below the 8-hour CO NAAQS standard of 9 ppm. These results demonstrate that traffic related to the FHWA/VDOT Preferred Alternative will not cause or

¹⁰ Consultant Guide Air Quality Project-Level Analysis, Revision 18: VDOT Environmental Division, Air Section, May 2009, Appendix 3 Background Carbon Monoxide Values.

contribute to a violation of the CO NAAQS within the project corridor, and thereby satisfies all NEPA and CAA requirements pertaining to CO.

7.2 PARTICULATE MATTER

The Project is located in Counties of Prince George, Sussex, Southampton, Surry, and Isle of Wight and City of Suffolk. All of these areas are designated by EPA as attainment for PM₁₀ and for PM_{2.5}; therefore, transportation conformity requirements pertaining to particulate matter do not apply for this Project. In addition, the latest monitoring data reported by the Virginia Department of Environmental Quality (VDEQ) shows that the 24-hour and annual PM_{2.5} background concentrations throughout the project corridor are less than 21 micrograms per cubic meter (ug/m³) and 9 ug/m³, respectively, which are both well below the respective PM_{2.5} NAAQS of 35 ug/m³ and 12 ug/m³.

7.3 MOBILE SOURCE AIR TOXICS ANALYSIS

7.3.1 Methodology

In December of 2012, the FHWA issued an interim guidance update regarding MSAT in a NEPA analysis to include the EPA MOVES emission model along with updated research on air toxic emissions from mobile sources. The guidance includes three categories and criteria for analyzing MSATs in a NEPA documents:

- 1. No meaningful MSAT effects,
- 2. Low potential MSAT effects, and
- 3. High potential MSAT effects.

A qualitative analysis is required for projects which meet the low potential MSAT effects criteria while a quantitative analysis is required for projects meeting the high potential MSAT effects criteria.

Projects with Low Potential MSAT Effects are described as:

• Those that serve to improve operations of highway, transit, freight without adding substantial new capacity or without creating a facility that is likely to significantly increase emissions. This category covers a broad range of project types including minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criteria.

Projects with High Potential MSAT Effects must:

- Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location;
- Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000 or greater by the design year; and
- Proposed to be located in proximity to populated areas.

Table 7-1 shows the forecasted ADT for the FHWA/VDOT Preferred Alternative for 2040 within the study corridor. The FHWA/VDOT Preferred Alternative will not add any capacity to Route 58, although it will build a new alignment roadway along the project corridor including bypassing the Town of Windsor as

shown in **Figure 1.4-1**. For the FHWA/VDOT Preferred Alternative, forecasted ADT in 2040 are expected to remain well below the 140,000 to 150,000 threshold for projects considered to have High Potential MSAT effects. Since the FHWA/VDOT Preferred Alternative is not the type of project that will add significant capacity to roadways with 140,000 to 150,000 ADT or greater by the design year, the project falls into the category of one having Low Potential MSAT Effects. Therefore, a qualitative analysis was conducted consistent with the latest FHWA guidance.

A qualitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, found at http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/methodology/methodology00.cfm as well as Appendix B and Appendix C of the guidance.

7.3.2 MSAT Background

Controlling air toxic emissions became a national priority with the passage of the 1990 CAAA, when Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants (HAPs). The EPA assessed this expansive list in their 2007 rule on the *Control of Hazardous Air Pollutants from Mobile Sources* and identified a group of 93 compounds emitted from mobile sources that are listed in their *Integrated Risk Information System (IRIS)*. In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 NATA. The seven compounds identified were:

- 1. acrolein;
- 2. benzene;
- 3. 1,3 butadiene;
- 4. diesel particulate matter;
- 5. formaldehyde;
- 6. naphthalene; and
- 7. polycyclic organic matter.

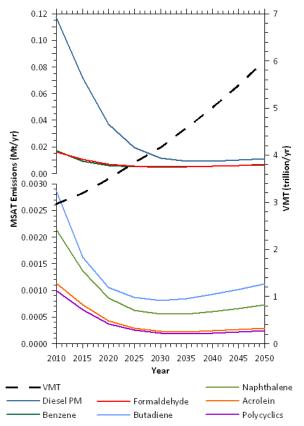
While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The 2007 EPA rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines.

7.3.3 MOVES

According to EPA, MOVES improves upon the previous MOBILE mode in several key aspects. MOVES is based on a vast amount of in-use vehicle data collected and analyzed since the latest release of MOBILE, including millions of emissions measurements from light-duty vehicles. Analysis of this data enhanced EPA's understanding of how mobile sources contribute to emission inventories and the relative effectiveness of various control strategies. In addition, MOVES accounts for the significant effects that vehicle speed and temperature have on PM emission estimates, whereas MOBILE did not. MOVES2010b includes all air toxic pollutants in NATA that are emitted by mobile sources. EPA has incorporated more recent data into MOVES2010b to update and enhance the quality of MSAT emission estimates. These data reflect advanced emission control technology and modern fuels, plus additional data for older technology vehicles.

Based on an FHWA analysis using EPA's MOVES2010b model, as shown in **Figure 7-4**, even if VMT increases by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period.

Figure 7-4: National MSAT Emission Trends 1999-2050 for Vehicles Operating on Roadways Using EPA's MOVES 2010b Model



Source: EPA MOVES2010b model runs conducted during May-June 2012 by FHWA.

Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles traveled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

The implications of MOVES on MSAT emissions estimates compared to MOBILE are: lower estimates of total MSAT emissions; significantly lower benzene emissions, significantly higher diesel PM emissions, especially for lower speeds. Consequently, diesel PM is projected to be the dominant component of the emissions total.

7.3.4 MSAT Research

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how potential public health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, we are duly expected by the public and other agencies to address MSAT impacts

in our environmental documents. The FHWA, EPA, the Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this field.

7.3.5 Project MSAT Impacts

The total VMT within the sixteen mile build portion of the FHWA/VDOT Preferred Alternative was estimated for the Existing, 2021 and 2040 Build and No Build Alternatives. The VMT estimates include traffic on existing Route 460 from just west of Zuni to new Route 460, plus new Route 460 to the Route 58/460 interchange, plus existing Route 460 from new Route 460 to Route 58. The results are presented in **Table 7-7**.

Alternative	Daily VMT	Distance (miles) ¹	Average Off Peak Speed (mph) ^{4,6}	Average Peak Period Speed (mph) ^{5,6}
Existing 2013	205,900	15	46.0	44.5
2021 No Build Existing Route 460 ²	243,700	15	45.4	43.2
2021 Build New Route 460 plus Existing Route 460 ³	321,800	16	58.4	57.4
2040 No Build Existing Route 460 ²	363,200	15	42.8	37.2
2040 Build New Route 460 plus Existing Route 460 ³	506,300	27	56.0	52.2

Table 7-7: Daily VMT Estimations within the Project Corridor

Notes:

- 1. Distances are as follows: Existing and No Build distances are from one mile west of Zuni to the westbound Route 58 interchange ramps intersection. The Build New Route 460 distance is from one mile west of Zuni to the merge/diverge for the system ramps from/to Route 58. The Build scenario also includes the existing Route 460 from the new Route 460 intersection west of Windsor to the westbound Route 58 interchange ramps intersection (see Note 3).
- 2. 2021 and 2040 No Build VMT corresponds to the existing stretch of Route 460 from the western project limit to the westbound Route 58 interchange.
- 3. 2021 and 2040 Build VMT corresponds to the new Route 460 distance from the western project limit to the merge/diverge plus existing Route 460 from the new Route 460 intersection to the Route 58 interchange.
- 4. Average Off Peak denotes the twelve hour period from 6 PM to 6 AM.
- 5. Average Peak Period denotes the periods from 6 AM to 9 AM and 3 PM to 6 PM.
- 6. The vehicle speeds represent the estimated speeds along the entire 16-mile project improvement corridor or the 15-mile existing corridor. The vehicle speeds along the 11 mile stretch of existing Route 460 from new Route 460 west of Windsor to Route 58 are as follows: for the 2021 No Build condition the average off peak and peak speed is estimated at 43.6 mph and 41.2 mph, respectively; while the 2021 Build condition average off peak and peak speed is estimated at 46.5 mph and 45.3 mph, respectively. Similarly, for the 2040 No Build condition, the average off peak and peak speed is estimated at 40.9 mph and 35.0 mph, respectively; while the 2040 Build condition average off peak and peak speed is estimated at 45.9 and 44.4 mph, respectively.

As shown in **Table 7-7**, the 2021 and 2040 VMT estimated for the FHWA/VDOT Preferred Alternative (321,800 and 506,300, respectively) through the 16-mile project improvement corridor is projected to be higher when compared to the Existing (205,900) and No Build Alternatives (243,700 and 363,200, respectively). The FHWA/VDOT Preferred Alternative for 2021 and 2040 VMT estimates are higher than the No Build Alternative because the project is anticipated to attract additional trips to the Route 460 corridor. **Table 7-7** also shows that average off-peak and average peak period vehicle speeds would increase with the FHWA/VDOT Preferred Alternative, including along the existing 11-mile portion of

Route 460 from new Route 460 to Route 58, which would help to offset any anticipated increase in MSAT emissions. The FHWA/VDOT Preferred Alternative includes VMT along the proposed 16-mile stretch of new roadway and traffic along the existing stretch of Route 460 from new Route 460 to Route 58.

The additional travel lanes contemplated as part of the FHWA/VDOT Preferred Alternative may have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under the FHWA/VDOT Preferred Alternative there may be localized areas where concentrations of MSAT could be higher under the FHWA/VDOT Preferred Alternative than the respective No Build Alternative in the design year. The localized increases in MSAT concentrations would likely be most pronounced along any new location sections within the project corridor. However, the magnitude and the duration of these potential increases compared to the No Build Alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSAT health impacts. In sum, the localized level of MSAT emissions for the FHWA/VDOT Preferred Alternative could be higher relative to the No Build Alternative in the design year, but this would likely be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions) as shown in **Table 7-7**. Also, MSAT will be lower in locations where traffic shifts away from them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time, cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than exist today.

Under the FHWA/VDOT Preferred Alternative there may be localized areas where VMT would increase, and other areas where VMT would decrease. Therefore, it is possible that localized increases and decreases in MSAT emissions may occur. However, even if these increases do occur, they too will be substantially reduced in the future due to implementation of EPA's vehicle and fuel regulations.

In sum, under the FHWA/VDOT Preferred Alternative in the design year, it is expected there could be higher MSAT emissions in the study area relative to the No Build Alternative due to increased VMT. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, as shown in **Figure 7-7**, EPA's vehicle and fuel regulations will bring about significantly lower MSAT levels for the area in the future than exist today.

7.3.6 Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the CAA and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the IRIS, which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/iris/). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance Update on Mobile source Air Toxic Analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the CAA to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities, in addition to improved access for emergency response, that are better suited for a quantitative analysis.

7.3.7 MSAT Conclusions

What we know about MSAT is still evolving. Information is currently incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with the FHWA/VDOT Preferred Alternative. Under the FHWA/VDOT Preferred Alternative, there may be slightly higher MSAT emissions in the design year relative to the No Build Alternative due to increased VMT. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today due to cleaner engine standards coupled with fleet turnover. The magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth), that MSAT emissions in the study area are likely to be significantly lower in the future than they are today, regardless of the whether the FHWA/VDOT Preferred Alternative is constructed.

8.0 CLIMATE CHANGE AND GREENHOUSE GAS IMPACTS

Climate change is a critical national and global concern. Human activity is changing the earth's climate by causing the buildup of heat-trapping greenhouse gas (GHG) emissions through the burning of fossil fuels and other human activities. Carbon dioxide (CO₂) is the largest component of human produced emissions; other prominent emissions include methane (CH₄), nitrous oxide (N₂O) and hydrofluorocarbons (HFCs). These emissions are different from criteria air pollutants since their effects in the atmosphere are global rather than localized, and also since they remain in the atmosphere for decades to centuries, depending on the species.

Greenhouse gas emissions have accumulated rapidly as the world has industrialized, with concentration of atmospheric CO₂ increasing from roughly 300 ppm in 1900 to over 400 ppm today. Over this timeframe, global average temperatures have increased by roughly 1.5 degrees Fahrenheit (1 degree Celsius), and the most rapid increases have occurred over the past 50 years. Scientists have warned that significant and potentially dangerous shifts in climate and weather are possible without substantial reductions in greenhouse gas emissions. They commonly have cited 2 degrees Celsius (1 degree Celsius beyond warming that has already occurred) as the total amount of warming the earth can tolerate without serious and potentially irreversible climate effects. For warming to be limited to this level, atmospheric concentrations of CO₂ would need to stabilize at a maximum of 450 ppm, requiring annual global emissions to be reduced 40-70 percent below 2010 levels by 2050.¹¹ State and national governments in many developed countries have set GHG emissions reduction targets of 80 percent below current levels by 2050, recognizing that post-industrial economies are primarily responsible for GHGs already in the atmosphere. As part of a 2014 bilateral agreement with China, the U.S. pledged to reduce GHG emissions 26-28 percent below 2005 levels

-

¹¹ IPCC, 2014: <u>Climate Change 2014: Synthesis Report Summary for Policymakers</u>. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

by 2025; this emissions reduction pathway is intended to support economy-wide reductions of 80 percent or more by 2050. 12

GHG emissions from vehicles using roadways are a function of distance traveled (expressed as VMT), vehicle speed, and road grade. GHG emissions are also generated during roadway construction and maintenance activities.

8.1 DAILY VEHICLE MILES TRAVELED REGIONWIDE

Since climate change is global in nature, it is more appropriate to consider the project's impact on the entire region to capture shifts in VMT more systematically. Using the Tidewater Superregional Travel Demand Model results, the No Build Alternative shows an increase in daily VMT on the regional network from 87.7 million in 2013 to 118.2 million in 2040, an increase of 30.5 million (34.8 percent). This increase is in line with the Energy Information Administration (EIA) national forecasts which indicate that VMT will increase by approximately 38 percent between 2012 and 2040 for the country as a whole. The regional network with the FHWA/VDOT Preferred Alternative shows an increase in the daily VMT from 87.7 million in 2013 to 118.3 million in 2040, an increase of 30.6 million (34.9 percent). The net increase due to the FHWA/VDOT Preferred Alternative is 80,000 VMT, a 0.07 percent increase over the No Build Alternative VMT in 2040. It is important to note that the model-wide vehicle hours traveled (VHT) decreases with the addition of the FHWA/VDOT Preferred Alternative. Thus while the VMT is projected to increase, VHT are expected to decrease within the larger region producing GHG emission benefits through expected increases in average vehicle speeds and a net reduction in total travel time.

A major factor in mitigating this increase in VMT is EPA's GHG emissions standards, implemented in concert with national fuel economy standards. EIA projects that vehicle energy efficiency (and thus, GHG emissions) on a per-mile basis will improve by 28 percent between 2012 and 2040. This improvement in vehicle emissions rates is more than sufficient to offset the small regional increase in VMT. Thus, it is expected that the project area would see a net reduction in GHG emissions under the FHWA/VDOT Preferred Alternative, even though VMT increases relative to the 2013 level.

8.2 VEHICLE SPEEDS AND DELAY

Other factors related to the project would also help reduce GHG emissions relative to the No Build Alternative. The shift in traffic to Route 460 reduces traffic (and therefore potential congestion) elsewhere in the system. The travel model forecast estimated a reduction of 7,810 hours of travel per day, which will reduce vehicle delay and idling. The project would increase the average travel speed throughout the study area, from 41 miles per hour (mph) in the No Build scenario to 48 mph in the FHWA/VDOT Preferred Alternative. GHG emissions rates decrease with speed over the range of average speeds encountered in this corridor, although the rates do increase at speeds higher than these average speeds. Finally, The FHWA/VDOT Preferred Alternative is predicted to have fewer crashes in 2040 even though the vehicle miles traveled on Route 460 in that scenario is forecasted to be over 45 percent greater. The number of crashes predicted in the No Build Alternative is 179, compared to 154 with the FHWA/VDOT Preferred

_

¹² "U.S.-China Joint Announcement on Climate Change," White House, Office of the Press Secretary, November 11, 2014, on the White House website, https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change, accessed June 5, 2015.

¹³ Calculated from Annual Energy Outlook 2015, Table A7.

Alternative. The safety improvements associated with the new route FHWA/VDOT Preferred Alternative would also produce emissions benefits by reducing vehicle delay and idling.

8.3 CONSTRUCTION AND MAINTENANCE

Construction and subsequent maintenance of the project would generate GHG emissions. Construction of the roadway (e.g., earth-moving activities) involves a considerable amount of energy consumption and resulting GHG emissions; manufacture of the materials used in construction and fuel used by construction equipment also contribute to GHG emissions. Typically, construction emissions associated with a new roadway account for approximately five percent of the total 20-year lifetime emissions from the roadway, although this can vary widely with the extent of construction activity and the number of vehicles that use the roadway.

The addition of new roadway miles to the study area roadway network would also increase the energy and GHG emissions associated with maintaining those new roadway miles in the future. The increase in maintenance needs due to the addition of new roadway infrastructure would be partially offset by the reduced need for maintenance on existing routes (because of lower total traffic and truck volumes on those routes).

In connection with GHG emissions, transportation system resiliency and adaptation to extreme weather events has been a focus area for USDOT. Climate change and extreme weather events present potentially significant risks to safety, reliability, effectiveness and sustainability of transportation infrastructure and operations. In 2008, the USDOT Center for Climate Change and Environmental Forecasting sponsored a study, *The Potential Impacts of Global Sea Level Rise on Transportation Infrastructure*. ¹⁴ The study was designed to produce high level estimates of the net effect of sea level rise and storm surge on the transportation network. As such, the study provides a broad, first look at potential sea level changes on the Atlantic coast using the predictions of global sea level rise from the Intergovernmental Panel on Climate Change (IPCC) Third and Fourth Assessment Reports. Due to the broad approach of the study and uncertainties in the models involved, the study considered sea level rise estimates from the IPCC study as uniform sea level rise estimates as opposed to estimates for a particular geographic location. The confidence stated by the IPCC in the regional distribution of sea level change is low due to significant variations in the included models; thus, according to the study, it is inappropriate to use the IPCC model series to estimate local changes in sea level rise.

The study evaluated nine scenarios of sea level rise between six and 59 centimeters. For each scenario, regularly inundated areas, at-risk areas, and the affected transportation system (i.e. highways, railroads, ports, and airports) were estimated. Based on the analysis, the FHWA/VDOT Preferred Alternative falls outside the estimated regularly inundated and at-risk areas due to sea level rise and storm surge for all scenarios. This is not to say that the project area would not be subject to extreme weather events and associated flooding. As documented in Chapter 1, outdated design standards related to the elevation of existing Route 460 makes it prone to flooding at several locations within the corridor, which has closed sections of Route 460 in the past. Of these flooding locations, three primary flood-prone areas were identified in or near Zuni, Wakefield and Waverly. The flood-prone area in Zuni, which is in the limits of the FHWA/VDOT Preferred Alternative, is associated with the Blackwater River and addressed as part of

_

¹⁴ http://climate.dot.gov/impacts-adaptations/pdf/entire.pdf

the project. A new bridge crossing approximately 500 feet in length and fourteen feet higher than it is today will be provided over the Blackwater River to satisfy hydraulic requirements. Over 4,000 feet of existing Route 460 will also be elevated in the approaches to the new bridge. For the sections of the FHWA/VDOT Preferred Alternative on new location, the roadway will be designed for a storm event with a lower probability of occurring (i.e. a storm event that would have a higher flood elevation associated with it) than existing Route 460 was designed for. New-location Route 460 is also an example of redundant infrastructure which is one strategy for adapting to extreme weather events; new-location Route 460 reduces the risk associated with flooding in the existing Route 460 corridor by providing an alternative when flooding leads to road closures.

9.0 CONSTRUCTION EMISSION ANALYSIS

The temporary air quality impacts from construction activities are expected to be minor. Construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications require compliance with all applicable local, state, and federal regulations.

The project corridor lies in volatile organic compounds (VOCs) and nitrogen oxides (NO_x) Emissions Control Area. As such, all reasonable precautions should be taken to limit the emissions of VOCs and NO_x. In addition, the following VDEQ air pollution regulations must be adhered to during construction: 9 VAC 5-130 et seq., Open Burning restrictions; 9 VAC 5-45, Article 7 et seq., Cutback Asphalt restrictions; and 9 VAC 5-50, Article 1 et seq., Fugitive Dust precautions.

10.0 CONCLUSION

The results of the CO hot-spot analysis show that the maximum anticipated CO concentrations will fall well below the CO NAAQS for the FHWA/VDOT Preferred Alternative in all analysis years, and therefore the project is not expected to cause or contribute to a violation of the CO NAAQS. In addition, the Project lies in an area designated attainment for all the NAAQS, therefore transportation conformity requirements do not currently apply.

The FHWA/VDOT Preferred Alternative was also assessed for MSAT impacts following the latest FHWA guidance for addressing MSATs in NEPA analyses. The FHWA/VDOT Preferred Alternative was identified as a project with Low Potential MSAT Effects; therefore, a qualitative analysis was conducted consistent with the guidance. The MSAT analysis showed that the FHWA/VDOT Preferred Alternative could generate slightly higher MSAT emissions in the study area relative to the No Build Alternative in the design year, and there could also be increases in MSAT levels in a few localized areas where VMT increases. However, the MSAT analysis demonstrated that no long-term adverse impacts associated with the FHWA/VDOT Preferred Alternative are anticipated, and that future MSAT emissions across the entire project corridor are expected to be significantly below today's levels due to EPA's vehicle and fuel regulations and continued fleet turnover.

Lastly, construction activities will be performed in accordance with VDOT's "Road and Bridge Specifications" as well as any applicable VDEQ regulations. These specifications require compliance with all applicable federal, state, and local air quality regulations.

In conclusion, the air quality analysis has demonstrated that the FHWA/VDOT Preferred Alternative being evaluated for the Route 460 Corridor Study Final SEIS is not expected to cause or contribute to a new

violation of any NAAQS, increase the frequency or severity of any violation, or delay timely attainment of any NAAQS.

LIST OF ACRONYMS

Acronym	Definition
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
BMPs	Best Management Practices
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CBA	Candidate Build Alternatives
CBA 1	New Alignment Alternative South of Existing Route 460
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CTB	Commonwealth Transportation Board
DEIS	Draft Environmental Impact Statement
DOD	Department of Defense
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
GHG	Greenhouse Gases
HAP	Hazardous Air Pollutant
HEI	Health Effects Institute
HFC	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IRIS	Integrated Risk Information System
ITS	Intelligent Transportation System
LEDPA	Least Environmentally Damaging Practicable Alternative
LOS	Level of Service
MPH	Miles Per Hour
MPOs	Metropolitan Planning Organizations
MOVES	Motor Vehicle Emissions Simulator
MSAT	Mobile Source Air Toxics
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NEPA	National Environmental Policy Act
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
O_3	Ozone

Pb Lead

PPM Parts Per Million
PM Particulate Matter

 PM_{10} Particle matter less than 10 microns $PM_{2.5}$ Particle matter less than 2.5 microns

POM Polycyclic Organic Matter

ROD Record of Decision

SEIS Supplemental Environmental Impact Statement

SIP State Implementation Plan

SO₂ Sulfur Dioxide

STRAHNET Strategic Highway Network
SYIP Six-Year Improvement Plan

TSM Transportation System Management

U.S. United States

USDOT United States Department of Transportation
USACE United States Army Corps of Engineers

VDEQ Virginia Department of Environmental Quality

VDOT Virginia Department of Transportation

VHT Vehicle Hours Traveled VMT Vehicle Miles Traveled

VOC Volatile Organic Compounds

APPENDIX A. TRAFFIC ANALYSIS (AVAILABLE UPON REQUEST)

APPENDIX B. SAMPLE MOVES INPUT AND OUTPUT FILES (COMPLETE SET OF FILES AVAILABLE UPON REQUEST)

MOVES Run Input File Eastern Terminus Route 460 and Route 58 Interchange 2040 Build Condition

<runspec></runspec>									
description> Route 460	460	Reevaluatio	n 2040	Build	Condtion	Route	58	at	< Existing
modelscale value="Inv"/>									<
modeldomain value="PROJECT"/	/>								<
geographicselections>									<
<pre>geographicselection type="CC</pre>	יי אידועדיי.	kon-"51900"	dogarint	-ion-"177	DCTNITA _ C	uffolk of	: + 11 /		<
	JONII	key- 31000	descript	JIOII- VI	KGINIA - S	Julioik Ci	гсу /		<
/geographicselections>									<
timespan>									
year key="2040"/>									<
month id="1"/>									<
									<
day id="5"/>									
beginhour id="8"/>									<
									<
endhour id="8"/>									
aggregateBy key="Hour"/>									<
/timespan>									<
onroadvehicleselections>									<
onroadvehicleselection f sourcetypeid="42" sourcetype				esc="Cor	mpressed	Natural	_	Gas	< (CNG)"
onroadvehicleselection f sourcetypename="Combination		peid="2" haul Truck"/	fueltype >	edesc="D	iesel :	Fuel"	sou	rcety	<pre>< peid="62"</pre>
onroadvehicleselection f sourcetypename="Combination		peid="2" -haul Truck"	fueltype />	edesc="D	iesel 1	Fuel"	soui	rcety	< peid="61"
onroadvehicleselection f sourcetypename="Intercity Bu		peid="2"	fueltype	edesc="D	iesel 1	Fuel"	soui	rcety	<pre></pre>
onroadvehicleselection f sourcetypename="Light Commen		peid="2" Truck"/>	fueltype	edesc="D	iesel :	Fuel"	soui	rcety	<pre></pre>

<pre>onroadvehicleselection fueltypeid="2" sourcetypename="Motor Home"/></pre>	fueltypedesc="Diesel	Fuel"	sourcetypeid="54"
<pre>onroadvehicleselection fueltypeid="2" sourcetypename="Motorcycle"/></pre>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="11"</pre>
onroadvehicleselection fueltypeid="2" sourcetypename="Passenger Car"/>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="21"</pre>
onroadvehicleselection fueltypeid="2" sourcetypename="Passenger Truck"/>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="31"</pre>
<pre>onroadvehicleselection fueltypeid="2" sourcetypename="Refuse Truck"/></pre>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="51"</pre>
<pre>onroadvehicleselection fueltypeid="2" sourcetypename="School Bus"/></pre>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="43"</pre>
onroadvehicleselection fueltypeid="2" sourcetypename="Single Unit Long-haul Truck"/	fueltypedesc="Diesel">	Fuel"	<pre>sourcetypeid="53"</pre>
onroadvehicleselection fueltypeid="2" sourcetypename="Single Unit Short-haul Truck"	fueltypedesc="Diesel //>	Fuel"	<pre>sourcetypeid="52"</pre>
<pre>onroadvehicleselection fueltypeid="2" sourcetypename="Transit Bus"/></pre>	fueltypedesc="Diesel	Fuel"	<pre>sourcetypeid="42"</pre>
onroadvehicleselection fueltypeid="1" sourcetypename="Combination Long-haul Truck"/	fueltypedesc="Gasol">	line"	<pre>sourcetypeid="62"</pre>
onroadvehicleselection fueltypeid="1" sourcetypename="Combination Short-haul Truck"	fueltypedesc="Gasol"/>	ine"	<pre>sourcetypeid="61"</pre>
<pre>onroadvehicleselection fueltypeid="1" sourcetypename="Intercity Bus"/></pre>	fueltypedesc="Gasol	line"	<pre>sourcetypeid="41"</pre>
onroadvehicleselection fueltypeid="1" sourcetypename="Light Commercial Truck"/>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="32"</pre>
<pre>onroadvehicleselection fueltypeid="1" sourcetypename="Motor Home"/></pre>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="54"</pre>
<pre>onroadvehicleselection fueltypeid="1" sourcetypename="Motorcycle"/></pre>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="11"</pre>
onroadvehicleselection fueltypeid="1" sourcetypename="Passenger Car"/>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="21"</pre>
onroadvehicleselection fueltypeid="1" sourcetypename="Passenger Truck"/>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="31"</pre>
<pre>onroadvehicleselection fueltypeid="1" sourcetypename="Refuse Truck"/></pre>	fueltypedesc="Gasol	ine"	<pre>sourcetypeid="51"</pre>

```
onroadvehicleselection
                             fueltypeid="1"
                                                    fueltypedesc="Gasoline"
                                                                                   sourcetypeid="43"
sourcetypename="School Bus"/>
                             fueltypeid="1"
                                                                                   sourcetypeid="53"
onroadvehicleselection
                                                    fueltypedesc="Gasoline"
sourcetypename="Single Unit Long-haul Truck"/>
                             fueltypeid="1"
                                                   fueltypedesc="Gasoline"
onroadvehicleselection
                                                                                   sourcetypeid="52"
sourcetypename="Single Unit Short-haul Truck"/>
onroadvehicleselection
                             fueltypeid="1"
                                                   fueltypedesc="Gasoline"
                                                                                   sourcetypeid="42"
sourcetypename="Transit Bus"/>
/onroadvehicleselections>
                                                                                                   <
offroadvehicleselections>
/offroadvehicleselections>
offroadvehiclesccs>
/offroadvehiclesccs>
roadtypes>
roadtype roadtypeid="4" roadtypename="Urban Restricted Access"/>
roadtype roadtypeid="5" roadtypename="Urban Unrestricted Access"/>
/roadtypes>
pollutantprocessassociations>
pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="1"
processname="Running Exhaust"/>
pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="15"
processname="Crankcase Running Exhaust"/>
                                                                                                   <
/pollutantprocessassociations>
databaseselections>
                                                                                                   <
/databaseselections>
internalcontrolstrategies>
<internalcontrolstrategy</pre>
\verb|classname| = "gov.epa.otaq.moves.master.implementation.ghg.internal control strategies.rate of progress.
RateOfProgressStrategy"><! [CDATA[</pre>
useParameters
                                                                                                  Ν
]]></internalcontrolstrategy>
/internalcontrolstrategies>
                                                                                                   <
inputdatabase servername="" databasename="" description=""/>
uncertaintyparameters
                              uncertaintymodeenabled="false"
                                                                      numberofrunspersimulation="0"
numberofsimulations="0"/>
                                                                                                   <
geographicoutputdetail description="LINK"/>
```

```
<
outputemissionsbreakdownselection>
modelyear selected="false"/>
fueltype selected="false"/>
emissionprocess selected="false"/>
onroadoffroad selected="true"/>
roadtype selected="false"/>
sourceusetype selected="false"/>
movesvehicletype selected="false"/>
onroadscc selected="false"/>
offroadscc selected="false"/>
                       selected="false" numberOfIterations="2"
                                                                          keepSampledData="false"
estimateuncertaintv
keepIterations="false"/>
sector selected="false"/>
engtechid selected="false"/>
hpclass selected="false"/>
/outputemissionsbreakdownselection>
outputdatabase servername="" databasename="4602040BD02" description=""/>
outputtimestep value="Hour"/>
outputvmtdata value="true"/>
outputsho value="false"/>
outputsh value="false"/>
outputshp value="false"/>
outputshidling value="false"/>
outputstarts value="false"/>
outputpopulation value="true"/>
scaleinputdatabase servername="localhost" databasename="4602040bd dat2" description=""/>
                                                                                                <
pmsize value="0"/>
outputfactors>
timefactors selected="true" units="Hours"/>
```

```
distancefactors selected="true" units="Miles"/>

massfactors selected="true" units="Grams" energyunits="Million BTU"/>

/outputfactors>
savedata>

/savedata>

donotexecute>

/donotexecute>

generatordatabase shouldsave="false" servername="" databasename="" description=""/>

donotperformfinalaggregation selected="false"/>

lookuptableflags scenarioid="" truncateoutput="true" truncateactivity="true"/>
</runspec>
```

MOVES OUTPUT Eastern Terminus Route 460 and Route 58 Interchange 2040 Build Condition

movesRunId	yearld	monthId	dayld	hourld	linkId	pollutan	GramsPerVehMile	GramsPerVehHour
1	2040	1	5	8	1	СО	2.459646	NULL
1	2040	1	5	8	2	СО	2.312972	NULL
1	2040	1	5	8	3	СО	2.459646	NULL
1	2040	1	5	8	4	СО	NULL	4.841974
1	2040	1	5	8	5	СО	2.459647	NULL
1	2040	1	5	8	6	СО	2.45965	NULL
1	2040	1	5	8	7	СО	2.459638	NULL
1	2040	1	5	8	8	СО	NULL	4.84198
1	2040	1	5	8	9	СО	NULL	4.84198
1	2040	1	5	8	10	СО	2.354889	NULL
1	2040	1	5	8	11	СО	2.312972	NULL
1	2040	1	5	8	12	СО	NULL	4.841977
1	2040	1	5	8	13	СО	3.180622	NULL
1	2040	1	5	8	14	СО	3.9186	NULL
1	2040	1	5	8	15	СО	NULL	4.841975
1	2040	1	5	8	16	СО	5.879827	NULL
1	2040	1	5	8	17	СО	5.879827	NULL
1	2040	1	5	8	18	СО	5.879827	NULL
1	2040	1	5	8	19	СО	5.879827	NULL
1	2040	1	5	8	20	СО	5.879827	NULL
1	2040	1	5	8	21	СО	5.879821	NULL
1	2040	1	5	8	22	СО	5.879821	NULL

1	2040	1	5	8	23	СО	5.879821	NULL
1	2040	1	5	8	24	СО	5.879821	NULL
1	2040	1	5	8	25	СО	5.879821	NULL
1	2040	1	5	8	26	СО	5.879821	NULL
1	2040	1	5	8	27	СО	5.879821	NULL
1	2040	1	5	8	28	СО	5.879821	NULL
1	2040	1	5	8	29	СО	5.879821	NULL
1	2040	1	5	8	30	СО	5.879821	NULL
1	2040	1	5	8	31	СО	5.879821	NULL
1	2040	1	5	8	32	СО	5.879833	NULL
1	2040	1	5	8	33	СО	5.879833	NULL
1	2040	1	5	8	34	СО	5.879833	NULL
1	2040	1	5	8	35	СО	5.879833	NULL
1	2040	1	5	8	36	СО	5.879833	NULL
1	2040	1	5	8	37	СО	5.879833	NULL
1	2040	1	5	8	38	СО	5.879833	NULL
1	2040	1	5	8	39	СО	5.384768	NULL
1	2040	1	5	8	40	СО	5.384768	NULL
1	2040	1	5	8	41	СО	5.384768	NULL
1	2040	1	5	8	42	СО	5.384768	NULL
1	2040	1	5	8	43	СО	5.384768	NULL
1	2040	1	5	8	44	СО	5.384768	NULL
1	2040	1	5	8	45	СО	5.384768	NULL
1	2040	1	5	8	46	СО	5.384768	NULL
1	2040	1	5	8	47	СО	3.058018	NULL
1	2040	1	5	8	48	СО	3.058018	NULL
1	2040	1	5	8	49	СО	3.058018	NULL
1	2040	1	5	8	50	СО	3.058018	NULL
1	2040	1	5	8	51	СО	3.058018	NULL
1	2040	1	5	8	52	СО	3.058018	NULL
1	2040	1	5	8	53	СО	3.058018	NULL
1	2040	1	5	8	54	СО	3.058018	NULL
1	2040	1	5	8	55	СО	3.058018	NULL
1	2040	1	5	8	56	СО	3.058018	NULL
1	2040	1	5	8	57	СО	3.058018	NULL
1	2040	1	5	8	58	СО	2.707488	NULL
1	2040	1	5	8	59	СО	2.707488	NULL
1	2040	1	5	8	60	СО	2.707488	NULL
1	2040	1	5	8	61	СО	2.79458	NULL
1	2040	1	5	8	62	СО	2.79458	NULL
1	2040	1	5	8	63	СО	2.79458	NULL
1	2040	1	5	8	64	СО	3.198218	NULL
1	2040	1	5	8	65	СО	3.152346	NULL

1	2040	1	5	8	66	СО	3.152346	NULL
1	2040	1	5	8	67	СО	3.152346	NULL
1	2040	1	5	8	68	СО	3.15234	NULL
1	2040	1	5	8	69	СО	4.527326	NULL
1	2040	1	5	8	70	СО	4.527333	NULL
1	2040	1	5	8	71	СО	4.527333	NULL
1	2040	1	5	8	72	СО	NULL	4.841972
1	2040	1	5	8	73	СО	NULL	4.841982
1	2040	1	5	8	74	СО	3.453286	NULL
1	2040	1	5	8	75	СО	3.453284	NULL
1	2040	1	5	8	76	СО	3.453283	NULL
1	2040	1	5	8	77	СО	3.453283	NULL
1	2040	1	5	8	78	СО	3.453283	NULL
1	2040	1	5	8	79	СО	3.453283	NULL
1	2040	1	5	8	80	СО	3.453283	NULL
1	2040	1	5	8	81	СО	3.453283	NULL
1	2040	1	5	8	82	СО	3.453283	NULL
1	2040	1	5	8	83	СО	3.453283	NULL
1	2040	1	5	8	84	СО	3.453282	NULL
1	2040	1	5	8	85	СО	3.453282	NULL
1	2040	1	5	8	86	СО	3.453282	NULL
1	2040	1	5	8	87	СО	3.453282	NULL
1	2040	1	5	8	88	СО	3.453282	NULL
1	2040	1	5	8	89	СО	3.453285	NULL
1	2040	1	5	8	90	СО	3.453287	NULL
1	2040	1	5	8	91	СО	3.453287	NULL
1	2040	1	5	8	92	СО	3.453287	NULL
1	2040	1	5	8	93	СО	3.453287	NULL
1	2040	1	5	8	94	СО	3.453281	NULL
1	2040	1	5	8	95	СО	3.453287	NULL
1	2040	1	5	8	96	СО	3.453287	NULL
1	2040	1	5	8	97	СО	3.453287	NULL
1	2040	1	5	8	98	СО	3.453281	NULL
1	2040	1	5	8	99	СО	3.453281	NULL
1	2040	1	5	8	100	СО	3.453281	NULL
1	2040	1	5	8	101	СО	3.453281	NULL
1	2040	1	5	8	102	СО	3.453281	NULL
1	2040	1	5	8	103	СО	3.453281	NULL
1	2040	1	5	8	104	СО	3.453286	NULL
1	2040	1	5	8	105	СО	6.377292	NULL
1	2040	1	5	8	106	СО	5.728141	NULL
1	2040	1	5	8	107	СО	5.728141	NULL
1	2040	1	5	8	108	СО	3.62334	NULL

1	2040	1	5	8	109	СО	3.62334	NULL
1	2040	1	5	8	110	СО	2.922241	NULL
1	2040	1	5	8	111	СО	3.504862	NULL
1	2040	1	5	8	112	СО	3.504862	NULL
1	2040	1	5	8	113	СО	3.504862	NULL
1	2040	1	5	8	114	СО	3.504862	NULL
1	2040	1	5	8	115	СО	3.918593	NULL
1	2040	1	5	8	116	СО	3.9186	NULL
1	2040	1	5	8	117	СО	NULL	4.841967
1	2040	1	5	8	118	СО	2.707488	NULL
1	2040	1	5	8	119	СО	3.9186	NULL
1	2040	1	5	8	120	СО	NULL	4.841984
1	2040	1	5	8	121	СО	NULL	4.841971
1	2040	1	5	8	122	СО	2.459648	NULL
1	2040	1	5	8	123	СО	2.35489	NULL
1	2040	1	5	8	124	СО	2.312974	NULL
1	2040	1	5	8	125	СО	NULL	4.841975
1	2040	1	5	8	126	СО	2.312973	NULL
1	2040	1	5	8	127	СО	2.31297	NULL
1	2040	1	5	8	128	СО	2.312968	NULL
1	2040	1	5	8	129	СО	2.31297	NULL
1	2040	1	5	8	130	СО	2.4111	NULL
1	2040	1	5	8	131	СО	2.354886	NULL
1	2040	1	5	8	132	СО	NULL	4.841977

APPENDIX C. SAMPLE CAL3QHC INPUT AND OUTPUT FILES (COMPLETE SET OF FILES AVAILABLE UPON REQUEST)

CAL3QHC Input Eastern Terminus Route 460 and Route 58 Interchange 2040 AM Build Condition

```
'Route 460 and Route 58 CAL3QHC Runs', 60, 175, 0.0, 0.0, 60, 0.3048, 1, 0
'Rec 1',35668.8,44512.0,5.9
'Rec 2',36061.6,44202.7,5.9
'Rec 3',36401.8,43838.5,5.9
'Rec 4',36728.5,43461.4,5.9
'Rec 5',36948.9,43069.5,5.9
'Rec 6',37005.1,42574.1,5.9
'Rec 7',36843.9,41839.6,5.9
'Rec 8',36983.4,41805.3,5.9
'Rec 9',37179.0,42529.3,5.9
'Rec 10',37371.3,42990.1,5.9
'Rec 11',37641.8,43443.2,5.9
'Rec 12',38037.3,43749.2,5.9
'Rec 13',38536.8,43727.6,5.9
'Rec 14',38759.9,43845.0,5.9
'Rec 15',38883.2,44009.8,5.9
'Rec 16',39140.7,44005.7,5.9
'Rec 17',38914.2,44112.0,5.9
'Rec 18',38694.5,44239.2,5.9
'Rec 19',38879.4,44421.8,5.9
'Rec 20',39061.5,44593.6,5.9
'Rec 21',39261.6,44738.6,5.9
'Rec 22',39487.9,44843.0,5.9
'Rec 23',39726.4,44918.0,5.9
'Rec 24',37144.7,42201.0,5.9
'Rec 25',37540.7,42602.8,5.9
'Rec 26',37148.1,43238.5,5.9
'Rec 27',37284.5,43747.8,5.9
'Rec 28',39709.9,45126.0,5.9
'Rec 29',39213.3,45023.4,5.9
'Rec 30',38742.5,44880.1,5.9
'Rec 31',38511.8,44797.8,5.9
'Rec 32',38268.2,44728.7,5.9
'Rec 33',38169.6,44717.5,5.9
'Rec 34',38070.1,44728.0,5.9
'Rec 35',37975.9,44761.5,5.9
'Rec 36',37891.2,44814.6,5.9
'Rec 37',37726.4,44928.0,5.9
'Rec 38',38170.8,44595.4,5.9
'Rec 39',38251.8,44536.7,5.9
'Rec 40',38332.8,44478.1,5.9
'Rec 41',38198.1,44471.9,5.9
'Rec 42',38117.1,44530.5,5.9
'Rec 43',37672.0,44852.9,5.9
'Rec 44',37832.8,44734.0,5.9
'Rec 45',37910.0,44670.4,5.9
```

```
'Rec 46',37987.2,44606.8,5.9
'Rec 47',38049.1,44528.2,5.9
'Rec 48',38020.3,44432.5,5.9
'Rec 49',37918.0,44238.1,5.9
'Rec 50',37456.1,43953.6,5.9
'Rec 51',36958.1,43920.7,5.9
'Rec 52',36520.1,44040.3,5.9
'Rec 53',36132.4,44292.0,5.9
'Rec 54',35734.3,44605.6,5.9
'Rec 55',39380.0,43773.8,5.9
'Rec 56',39424.0,43871.4,5.9
'Rec 57',39522.7,43982.1,5.9
'Rec 58',39572.8,43957.3,5.9
'Rec 59',39548.1,43814.8,5.9
'Rec 60',39509.7,43730.2,5.9
'2040 Build AM', 132, 1, 0, 'CO'
'EB460 A 01', 'AG', 37483.2, 45018.5, 37846.9, 44753.5, 960, 2.5, 0, 44
'EBE460 IN 01', 'AG', 38852, 44076.1, 38498.2, 44288.9, 760, 2.3, 0, 44
'EBE460 OUT 01', 'AG', 38852, 44076.1, 39179, 43911.9, 1010, 2.5, 0, 34
'EBE460 Q 01', 'AG', 38821.6, 44093.5, 38498.2, 44288.9, 760, 4.8, 0, 34
'EBSR IN 01', 'AG', 39179, 43911.9, 39454, 43781.7, 920, 2.5, 0, 44
'EBSR LT 01', 'AG', 39414, 43814.9, 39184.8, 43923.4, 40, 2.5, 0, 32
'EBSR OUT 01', 'AG', 39454, 43781.7, 39761.3, 43647.3, 960, 2.5, 0, 44
'EBSR Q 01', 'AG', 39408.5, 43803.3, 39179, 43911.9, 0, 24, 2
60,55,2,1010,4.8,1600,2,3
'EBSR RT 01', 'AG', 39400.8, 43787, 39171.3, 43895.6, 50, 4.8, 0, 32
'EBW460 IN 01', 'AG', 38122.6, 44552.4, 37846.9, 44753.5, 880, 2.4, 0, 44
'EBW460 OUT 01','AG',38122.6,44552.4,38498.2,44288.9,990,2.3,0,34
'EBW460 Q 01', 'AG', 38096.3, 44570.7, 37846.9, 44753.5, 0, 24, 2
90, 29, 2, 880, 4.8, 1600, 2, 3
'NB LT 01','AG',38850,44051.8,38777.6,43920.4,110,3.2,0,32
'NBSR IN 01','AG',39351.4,43564.3,39473,43786.9,80,3.9,0,32
'NBSR Q 01', 'AG', 39447.3, 43739.8, 39351.4, 43564.3, 0, 12, 1
60,55,2,80,4.8,1600,2,3
'RAMP A 01', 'AG', 36082, 44217.2, 36745.2, 43476.7, 160, 5.9, 0, 32
```

```
'RAMP A 02', 'AG', 36745.2, 43476.7, 36896.1, 43243.6, 160, 5.9, 0, 32
'RAMP A 03', 'AG', 36896.1, 43243.6, 36998.9, 42963, 160, 5.9, 0, 32
'RAMP A 04', 'AG', 36998.9, 42963, 37024.5, 42574.2, 160, 5.9, 0, 32
'RAMP A 05', 'AG', 37024.5, 42574.2, 36927.1, 42075.9, 160, 5.9, 0, 32
'RAMP B 01', 'AG', 36082, 44217.2, 36393.1, 44004.9, 840, 5.9, 0, 32
'RAMP B 02', 'AG', 36393.1, 44004.9, 36659.6, 43879, 840, 5.9, 0, 32
'RAMP B 03', 'AG', 36659.6, 43879, 37005, 43790.5, 840, 5.9, 0, 32
'RAMP B 04', 'AG', 37005, 43790.5, 37350.4, 43764.5, 840, 5.9, 0, 32
'RAMP B 05', 'AG', 37350.4, 43764.5, 37726.8, 43801.3, 840, 5.9, 0, 32
'RAMP B 06', 'AG', 37726.8, 43801.3, 38077.5, 43896.4, 840, 5.9, 0, 32
'RAMP B 07', 'AG', 38077.5, 43896.4, 38435.1, 44074.9, 840, 5.9, 0, 32
'RAMP B 08', 'AG', 38435.1, 44074.9, 38697.6, 44275.6, 840, 5.9, 0, 32
'RAMP B 09', 'AG', 38697.6, 44275.6, 38959.6, 44522.4, 840, 5.9, 0, 32
'RAMP B 10', 'AG', 38959.6, 44522.4, 39161.5, 44698, 840, 5.9, 0, 32
'RAMP B 11', 'AG', 39161.5, 44698, 39505.3, 44887.8, 840, 5.9, 0, 32
'RAMP C 01', 'AG', 39783.8, 45118.3, 39179.5, 44938.5, 640, 5.9, 0, 32
'RAMP C 02', 'AG', 39179.5, 44938.5, 38646.5, 44663.3, 640, 5.9, 0, 32
'RAMP C 03', 'AG', 38646.5, 44663.3, 37806.3, 44060.3, 640, 5.9, 0, 32
'RAMP C 04', 'AG', 37806.3, 44060.3, 37460.7, 43936.8, 640, 5.9, 0, 32
'RAMP C 05', 'AG', 37460.7, 43936.8, 36953.8, 43902.9, 640, 5.9, 0, 32
'RAMP C 06', 'AG', 36953.8, 43902.9, 36511, 44024.4, 640, 5.9, 0, 32
'RAMP C 07', 'AG', 36511, 44024.4, 36254.8, 44164.9, 640, 5.9, 0, 32
'RAMP D 01', 'AG', 36950.8, 41723.1, 37018.1, 41999.2, 120, 5.4, 0, 32
'RAMP D 02', 'AG', 37018.1, 41999.2, 37128.3, 42214.3, 120, 5.4, 0, 32
'RAMP D 03', 'AG', 37128.3, 42214.3, 37283.5, 42347.1, 120, 5.4, 0, 32
'RAMP D 04', 'AG', 37283.5, 42347.1, 37472.6, 42480.7, 120, 5.4, 0, 32
```

```
'RAMP D 05', 'AG', 37472.6, 42480.7, 37525.6, 42611.7, 120, 5.4, 0, 32
'RAMP D 06', 'AG', 37525.6, 42611.7, 37489.6, 42828.4, 120, 5.4, 0, 32
'RAMP D 07', 'AG', 37489.6, 42828.4, 36588.5, 43841.2, 120, 5.4, 0, 32
'RAMP D 08', 'AG', 36588.5, 43841.2, 36254.8, 44164.9, 120, 5.4, 0, 32
'RAMP E 01', 'AG', 37073.9, 42297.9, 37196.7, 42625.7, 360, 3.1, 0, 32
'RAMP E 02', 'AG', 37196.7, 42625.7, 37290.8, 42857.3, 360, 3.1, 0, 32
'RAMP E 03', 'AG', 37290.8, 42857.3, 37448.7, 43169.7, 360, 3.1, 0, 32
'RAMP E 04', 'AG', 37448.7, 43169.7, 37577.9, 43383.7, 360, 3.1, 0, 32
'RAMP E 05', 'AG', 37577.9, 43383.7, 37729.2, 43582.7, 360, 3.1, 0, 32
'RAMP E 06', 'AG', 37729.2, 43582.7, 37846.4, 43676.3, 360, 3.1, 0, 32
'RAMP E 07', 'AG', 37846.4, 43676.3, 38123.6, 43784.8, 360, 3.1, 0, 32
'RAMP E 08', 'AG', 38123.6, 43784.8, 38394.1, 43748.1, 360, 3.1, 0, 32
'RAMP E 09', 'AG', 38394.1, 43748.1, 38638.2, 43779.9, 360, 3.1, 0, 32
'RAMP E 10', 'AG', 38638.2, 43779.9, 38785.6, 43916.5, 360, 3.1, 0, 32
'RAMP E 11', 'AG', 38785.6, 43916.5, 38872.6, 44074.3, 360, 3.1, 0, 32
'RAMP F 01', 'AG', 38335.9, 44718.7, 38136.8, 44699.6, 140, 2.7, 0, 32
'RAMP F 02', 'AG', 38136.8, 44699.6, 37990.1, 44731, 140, 2.7, 0, 32
'RAMP F 03', 'AG', 37990.1, 44731, 37855.3, 44796.7, 140, 2.7, 0, 32
'RAMP G 01', 'AG', 37846.9, 44753.5, 38037.5, 44591.7, 80, 2.8, 0, 32
'RAMP G 02', 'AG', 38037.5, 44591.7, 38068.1, 44552.1, 80, 2.8, 0, 32
'RAMP G 03', 'AG', 38068.1, 44552.1, 38069.8, 44483.7, 80, 2.8, 0, 32
'RAMP H 01', 'AG', 38104.8, 44550, 38069.8, 44483.7, 70, 3.2, 0, 32
'RAMP J 01', 'AG', 38498.2, 44288.9, 38678, 44115.2, 230, 3.2, 0, 32
'RAMP J 02', 'AG', 38678, 44115.2, 38709.2, 44020.2, 230, 3.2, 0, 32
'RAMP J 03', 'AG', 38709.2, 44020.2, 38698.1, 43920.8, 230, 3.2, 0, 32
'RAMP J 04', 'AG', 38698.1, 43920.8, 38601.3, 43812.7, 230, 3.2, 0, 32
```

```
'RAMP K 01', 'AG', 38825, 44076.9, 38752.7, 43945.5, 60, 4.5, 0, 32
'RAMP K 02', 'AG', 38752.7, 43945.5, 38687.3, 43869.8, 60, 4.5, 0, 32
'RAMP K 03', 'AG', 38687.3, 43869.8, 38601.3, 43812.7, 60, 4.5, 0, 32
'RAMPE Q 01', 'AG', 38858, 44048, 38785.6, 43916.5, 0, 12, 1
90,67,2,360,4.8,1600,2,3
'RAMPF Q 01', 'AG', 38155.3, 44612.7, 38335.9, 44718.7, 0, 12, 1
90,73,2,110,4.8,1600,2,3
'RT58 NB 01', 'AG', 36833.3, 41327.3, 36931.6, 41727.9, 2470, 3.5, 0, 44
'RT58 NB 02', 'AG', 36931.6, 41727.9, 37073.9, 42297.9, 2350, 3.5, 0, 44
'RT58 NB 03', 'AG', 37073.9, 42297.9, 37177.6, 42632.2, 1990, 3.5, 0, 44
'RT58 NB 04', 'AG', 37177.6, 42632.2, 37272.9, 42866, 1990, 3.5, 0, 44
'RT58 NB 05', 'AG', 37272.9, 42866, 37430.7, 43175.7, 1990, 3.5, 0, 44
'RT58 NB 06', 'AG', 37430.7, 43175.7, 37559.6, 43389.9, 1990, 3.5, 0, 44
'RT58 NB 07', 'AG', 37559.6, 43389.9, 37702.8, 43594.9, 1990, 3.5, 0, 44
'RT58 NB 08', 'AG', 37702.8, 43594.9, 37926.9, 43863.8, 1990, 3.5, 0, 44
'RT58 NB 09', 'AG', 37926.9, 43863.8, 38102.5, 44041.6, 1990, 3.5, 0, 44
'RT58 NB 10', 'AG', 38102.5, 44041.6, 38328.1, 44239.4, 1990, 3.5, 0, 44
'RT58 NB 11', 'AG', 38328.1, 44239.4, 38530.9, 44385.6, 2280, 3.5, 0, 44
'RT58 NB 12', 'AG', 38530.9, 44385.6, 38738.9, 44524.3, 2280, 3.5, 0, 44
'RT58 NB 13', 'AG', 38738.9, 44524.3, 39044.3, 44695.3, 2280, 3.5, 0, 44
'RT58 NB 14', 'AG', 39044.3, 44695.3, 39270.9, 44800.8, 2280, 3.5, 0, 44
'RT58 NB 15', 'AG', 39270.9, 44800.8, 39505.3, 44887.8, 2280, 3.5, 0, 44
'RT58 NB 16', 'AG', 39505.3, 44887.8, 39813.6, 44977.3, 3120, 3.5, 0, 44
'RT58 SB 01', 'AG', 39793.4, 45061.5, 39552.3, 44995.4, 1450, 3.5, 0, 44
'RT58 SB 02', 'AG', 39552.3, 44995.4, 39315.2, 44915.9, 1450, 3.5, 0, 44
'RT58 SB 03', 'AG', 39315.2, 44915.9, 38861.6, 44705.7, 1450, 3.5, 0, 44
'RT58 SB 04', 'AG', 38861.6, 44705.7, 38439.8, 44437.2, 1450, 3.5, 0, 44
```

```
'RT58 SB 05', 'AG', 38439.8, 44437.2, 38241.7, 44284.7, 1450, 3.5, 0, 44
'RT58 SB 06', 'AG', 38241.7, 44284.7, 38054, 44119.6, 1450, 3.5, 0, 44
'RT58 SB 07', 'AG', 38054, 44119.6, 37878.5, 43941.5, 1450, 3.5, 0, 44
'RT58 SB 08', 'AG', 37878.5, 43941.5, 37559.8, 43556.3, 1450, 3.5, 0, 44
'RT58 SB 09', 'AG', 37559.8, 43556.3, 37428.2, 43343.7, 1600, 3.5, 0, 44
'RT58 SB 10', 'AG', 37428.2, 43343.7, 37304.1, 43126.7, 1600, 3.5, 0, 44
'RT58 SB 11', 'AG', 37304.1, 43126.7, 37193.8, 42902.3, 1600, 3.5, 0, 44
'RT58 SB 12', 'AG', 37193.8, 42902.3, 37100.3, 42670.4, 1600, 3.5, 0, 44
'RT58 SB 13', 'AG', 37100.3, 42670.4, 36993.5, 42337.1, 1600, 3.5, 0, 44
'RT58 SB 14', 'AG', 36993.5, 42337.1, 36927.1, 42075.9, 1600, 3.5, 0, 44
'RT58 SB 15', 'AG', 36927.1, 42075.9, 36748.9, 41348, 1760, 3.5, 0, 44
'RTAB 01','AG',35288.1,44839.8,36082,44217.2,1000,6.4,0,32
'RTCD 01', 'AG', 36254.8, 44164.9, 35479, 44810, 760, 5.7, 0, 32
'RTCD 02', 'AG', 35479, 44810, 35330.8, 44900.1, 760, 5.7, 0, 32
'RTF 01', 'AG', 39783.8, 45118.3, 39081.4, 44975.8, 250, 3.6, 0, 32
'RTF 02', 'AG', 39081.4, 44975.8, 38335.9, 44718.7, 250, 3.6, 0, 32
'RTGH 01', 'AG', 38069.8, 44483.7, 37559.8, 43556.3, 150, 2.9, 0, 32
'RTJK 01','AG',38601.3,43812.7,38404.9,43803.3,290,3.5,0,32
'RTJK 02', 'AG', 38404.9, 43803.3, 38246.1, 43919.2, 290, 3.5, 0, 32
'RTJK 03', 'AG', 38246.1, 43919.2, 38234.7, 44112.2, 290, 3.5, 0, 32
'RTJK 04','AG',38234.7,44112.2,38328.1,44239.4,290,3.5,0,32
'SADLER IN 01','AG',39567.5,44017,39454.5,43795.3,30,3.9,0,32
'SADLER OUT 01','AG',39473,43786.9,39578.3,44011.8,60,3.9,0,32
'SADLER Q 01', 'AG', 39476, 43837.5, 39567.5, 44017, 0, 12, 1
60,55,2,30,4.8,1600,2,3
'SB IN 01', 'AG', 38335.9, 44718.7, 38111.7, 44587, 110, 2.7, 0, 32
'SBSR OUT 01','AG',39454.5,43795.3,39335.9,43573.5,70,3.9,0,32
```

```
'WB LTQ1 01', 'AG', 38888.4, 44087.6, 39110.1, 43973, 0, 12, 1
90,73,2,60,4.8,1600,2,3
'WB LTQ2 01', 'AG', 38155.2, 44557.8, 38278.1, 44471.9, 0, 12, 1
90,80,2,70,4.8,1600,2,3
'WB460 B 01', 'AG', 37855.3, 44796.7, 37507.5, 45052, 580, 2.5, 0, 44
'WBE460 IN 01', 'AG', 38862.8, 44113.7, 39307.4, 43892, 400, 2.4, 0, 44
'WBE460 OUT 01', 'AG', 38862.8, 44113.7, 38520.1, 44322.4, 510, 2.3, 0, 44
'WBE460 Q 01', 'AG', 38893.9, 44098.2, 39307.4, 43892, 0, 24, 2
90, 35, 2, 400, 4.8, 1600, 2, 3
'WBSR IN 01', 'AG', 39771.2, 43670.8, 39471.2, 43815, 370, 2.3, 0, 44
'WBSR LT 01', 'AG', 39513.4, 43774.8, 39648.5, 43709.8, 20, 2.3, 0, 32
'WBSR OUT 01', 'AG', 39471.2, 43815, 39307.4, 43892, 460, 2.3, 0, 44
'WBSR RT 01', 'AG', 39779, 43687, 39528.4, 43807.5, 20, 2.3, 0, 32
'WBW460 IN 01','AG',38138.3,44589.1,38520.1,44322.4,440,2.4,0,44
'WBW460 OUT 01', 'AG', 38138.3, 44589.1, 37855.3, 44796.7, 440, 2.4, 0, 44
'WBW460 Q 01', 'AG', 38164.5, 44570.8, 38520.1, 44322.4, 0, 24, 2
90,23,2,440,4.8,1600,2,3
1.0,0,4,1000,0.0,'Y',5,1,72
```

CAL3QHC Output Eastern Terminus Route 460 and Route 58 Interchange 2040 AM Build Condition

PAGE 1

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 95221

PAGE 1

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

DATE: 11/11/15
TIME: 14:42: 7

The MODE flag has been set for calculating concentrations for POLLUTANT: CO

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM

U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 PPM

LINK VARIABLES

LINK DESCRIPTION * LINK COORDINATES (FT) * LENGTH BRG TYPE VPH EF H W V/C

QUEUE

* X1 Y1 X2 Y2 * (FT) (DEG) (G/MI) (FT) (FT) (VEH)

-----*-----*

7. EBSR_OUT_01 * 39454.0 43781.7 39761.3 43647.3 * 335. 114. AG 960. 2.5 0.0 44.0

11. EBW460_OUT_01 * 38122.6 44552.4 38498.2 44288.9 * 459. 125. AG 990. 2.3 0.0 34.0

13. NB_LT_01	* 38850.0 44051.8 38777.6 43920.4 * 150. 209. AG 110. 3.2 0.0 32.0
14. NBSR_IN_01	* 39351.4 43564.3 39473.0 43786.9 * 254. 29. AG 80. 3.9 0.0 32.0
15. NBSR_Q_01	* 39447.3 43739.8 39150.4 43196.4 * 619. 209. AG 12. 100.0 0.0 12.0 3.08 31.5
16. RAMP_A_01	* 36082.0 44217.2 36745.2 43476.7 * 994. 138. AG 160. 5.9 0.0 32.0
17. RAMP_A_02	* 36745.2 43476.7 36896.1 43243.6 * 278. 147. AG 160. 5.9 0.0 32.0
18. RAMP_A_03	* 36896.1 43243.6 36998.9 42963.0 * 299. 160. AG 160. 5.9 0.0 32.0
19. RAMP_A_04	* 36998.9 42963.0 37024.5 42574.2 * 390. 176. AG 160. 5.9 0.0 32.0
20. RAMP_A_05	* 37024.5 42574.2 36927.1 42075.9 * 508. 191. AG 160. 5.9 0.0 32.0
21. RAMP_B_01	* 36082.0 44217.2 36393.1 44004.9 * 377. 124. AG 840. 5.9 0.0 32.0
22. RAMP_B_02	* 36393.1 44004.9 36659.6 43879.0 * 295. 115. AG 840. 5.9 0.0 32.0
23. RAMP_B_03	* 36659.6 43879.0 37005.0 43790.5 * 357. 104. AG 840. 5.9 0.0 32.0
24. RAMP_B_04	* 37005.0 43790.5 37350.4 43764.5 * 346. 94. AG 840. 5.9 0.0 32.0
25. RAMP_B_05	* 37350.4 43764.5 37726.8 43801.3 * 378. 84. AG 840. 5.9 0.0 32.0
26. RAMP_B_06	* 37726.8 43801.3 38077.5 43896.4 * 363. 75. AG 840. 5.9 0.0 32.0
27. RAMP_B_07	* 38077.5 43896.4 38435.1 44074.9 * 400. 63. AG 840. 5.9 0.0 32.0
28. RAMP_B_08	* 38435.1 44074.9 38697.6 44275.6 * 330. 53. AG 840. 5.9 0.0 32.0
29. RAMP_B_09	* 38697.6 44275.6 38959.6 44522.4 * 360. 47. AG 840. 5.9 0.0 32.0
30. RAMP_B_10	* 38959.6 44522.4 39161.5 44698.0 * 268. 49. AG 840. 5.9 0.0 32.0
31. RAMP_B_11	* 39161.5 44698.0 39505.3 44887.8 * 393. 61. AG 840. 5.9 0.0 32.0
32. RAMP_C_01	* 39783.8 45118.3 39179.5 44938.5 * 630. 253. AG 640. 5.9 0.0 32.0
33. RAMP_C_02	* 39179.5 44938.5 38646.5 44663.3 * 600. 243. AG 640. 5.9 0.0 32.0
34. RAMP_C_03	* 38646.5 44663.3 37806.3 44060.3 * 1034. 234. AG 640. 5.9 0.0 32.0
35. RAMP_C_04	* 37806.3 44060.3 37460.7 43936.8 * 367. 250. AG 640. 5.9 0.0 32.0
36. RAMP_C_05	* 37460.7 43936.8 36953.8 43902.9 * 508. 266. AG 640. 5.9 0.0 32.0
37. RAMP_C_06	* 36953.8 43902.9 36511.0 44024.4 * 459. 285. AG 640. 5.9 0.0 32.0
38. RAMP_C_07	* 36511.0 44024.4 36254.8 44164.9 * 292. 299. AG 640. 5.9 0.0 32.0
39. RAMP_D_01	* 36950.8 41723.1 37018.1 41999.2 * 284. 14. AG 120. 5.4 0.0 32.0
40. RAMP_D_02	* 37018.1 41999.2 37128.3 42214.3 * 242. 27. AG 120. 5.4 0.0 32.0
41. RAMP_D_03	* 37128.3 42214.3 37283.5 42347.1 * 204. 49. AG 120. 5.4 0.0 32.0
42. RAMP_D_04	* 37283.5 42347.1 37472.6 42480.7 * 232. 55. AG 120. 5.4 0.0 32.0
43. RAMP_D_05	* 37472.6 42480.7 37525.6 42611.7 * 141. 22. AG 120. 5.4 0.0 32.0
44. RAMP_D_06	* 37525.6 42611.7 37489.6 42828.4 * 220. 351. AG 120. 5.4 0.0 32.0

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

DATE: 11/11/15
TIME: 14:42: 7

LINK VARIABLES

LINK DESCRIPTION * LINK COORDINATES (FT) * LENGTH BRG TYPE VPH EF H W V/C

QUEUE

* X1 Y1 X2 Y2 * (FT) (DEG) (G/MI) (FT) (FT) (VEH) 45. RAMP_D_07 * 37489.6 42828.4 36588.5 43841.2 * 1356. 318. AG 120. 5.4 0.0 32.0 46. RAMP_D_08 * 36588.5 43841.2 36254.8 44164.9 * 465. 314. AG 120. 5.4 0.0 32.0 47. RAMP_E_01 * 37073.9 42297.9 37196.7 42625.7 * 350. 21. AG 360. 3.1 0.0 32.0 48. RAMP_E_02 * 37196.7 42625.7 37290.8 42857.3 * 250. 22. AG 360. 3.1 0.0 32.0 49. RAMP_E_03 * 37290.8 42857.3 37448.7 43169.7 * 350. 27. AG 360. 3.1 0.0 32.0 50. RAMP_E_04 * 37448.7 43169.7 37577.9 43383.7 * 250. 31. AG 360. 3.1 0.0 32.0 51. RAMP_E_05 * 37577.9 43383.7 37729.2 43582.7 * 250. 37. AG 360. 3.1 0.0 32.0 52. RAMP_E_06 * 37729.2 43582.7 37846.4 43676.3 * 150. 51. AG 360. 3.1 0.0 32.0 * 37846.4 43676.3 38123.6 43784.8 * 53. RAMP_E_07 298. 69. AG 360. 3.1 0.0 32.0 54. RAMP_E_08 * 38123.6 43784.8 38394.1 43748.1 * 273. 98. AG 360. 3.1 0.0 32.0 55. RAMP_E_09 246. 83. AG 360. 3.1 0.0 32.0 * 38394.1 43748.1 38638.2 43779.9 * 56. RAMP_E_10 * 38638.2 43779.9 38785.6 43916.5 * 201. 47. AG 360. 3.1 0.0 32.0 57. RAMP_E_11 * 38785.6 43916.5 38872.6 44074.3 * 180. 29. AG 360. 3.1 0.0 32.0 58. RAMP_F_01 * 38335.9 44718.7 38136.8 44699.6 * 200. 265. AG 140. 2.7 0.0 32.0 150. 282. AG 140. 2.7 0.0 32.0 59. RAMP_F_02 * 38136.8 44699.6 37990.1 44731.0 * 60. RAMP_F_03 * 37990.1 44731.0 37855.3 44796.7 * 150. 296. AG 140. 2.7 0.0 32.0 61. RAMP_G_01 * 37846.9 44753.5 38037.5 44591.7 * 250. 130. AG 80. 2.8 0.0 32.0 62. RAMP G 02 * 38037.5 44591.7 38068.1 44552.1 * 50. 142. AG 80. 2.8 0.0 32.0 63. RAMP_G_03 * 38068.1 44552.1 38069.8 44483.7 * 68. 179. AG 80. 2.8 0.0 32.0 64. RAMP_H_01 * 38104.8 44550.0 38069.8 44483.7 * 75. 208. AG 70. 3.2 0.0 32.0 65. RAMP_J_01 * 38498.2 44288.9 38678.0 44115.2 * 250. 134. AG 230. 3.2 0.0 32.0

66. RAMP_J_02	* 38678.0 44115.2 38709.2 44020.2 * 100. 162. AG 230. 3.2 0.0 32.0	
67. RAMP_J_03	* 38709.2 44020.2 38698.1 43920.8 * 100. 186. AG 230. 3.2 0.0 32.0	
68. RAMP_J_04	* 38698.1 43920.8 38601.3 43812.7 * 145. 222. AG 230. 3.2 0.0 32.0	
69. RAMP_K_01	* 38825.0 44076.9 38752.7 43945.5 * 150. 209. AG 60. 4.5 0.0 32.0	
70. RAMP_K_02	* 38752.7 43945.5 38687.3 43869.8 * 100. 221. AG 60. 4.5 0.0 32.0	
71. RAMP_K_03	* 38687.3 43869.8 38601.3 43812.7 * 103. 236. AG 60. 4.5 0.0 32.0	
72. RAMPE_Q_01	* 38858.0 44048.0 38650.8 43671.6 * 430. 209. AG 10. 100.0 0.0 12.0 1.07 21.8	
73. RAMPF_Q_01	* 38155.3 44612.7 38193.2 44634.9 * 44. 60. AG 10. 100.0 0.0 12.0 0.48 2.2	
74. RT58_NB_01	* 36833.3 41327.3 36931.6 41727.9 * 412. 14. AG 2470. 3.5 0.0 44.0	
75. RT58_NB_02	* 36931.6 41727.9 37073.9 42297.9 * 587. 14. AG 2350. 3.5 0.0 44.0	
76. RT58_NB_03	* 37073.9 42297.9 37177.6 42632.2 * 350. 17. AG 1990. 3.5 0.0 44.0	
77. RT58_NB_04	* 37177.6 42632.2 37272.9 42866.0 * 252. 22. AG 1990. 3.5 0.0 44.0	
78. RT58_NB_05	* 37272.9 42866.0 37430.7 43175.7 * 348. 27. AG 1990. 3.5 0.0 44.0	
79. RT58_NB_06	* 37430.7 43175.7 37559.6 43389.9 * 250. 31. AG 1990. 3.5 0.0 44.0	
80. RT58_NB_07	* 37559.6 43389.9 37702.8 43594.9 * 250. 35. AG 1990. 3.5 0.0 44.0	
81. RT58_NB_08	* 37702.8 43594.9 37926.9 43863.8 * 350. 40. AG 1990. 3.5 0.0 44.0	
82. RT58_NB_09	* 37926.9 43863.8 38102.5 44041.6 * 250. 45. AG 1990. 3.5 0.0 44.0	
83. RT58_NB_10	* 38102.5 44041.6 38328.1 44239.4 * 300. 49. AG 1990. 3.5 0.0 44.0	
84. RT58_NB_11	* 38328.1 44239.4 38530.9 44385.6 * 250. 54. AG 2280. 3.5 0.0 44.0	
85. RT58_NB_12	* 38530.9 44385.6 38738.9 44524.3 * 250. 56. AG 2280. 3.5 0.0 44.0	
86. RT58_NB_13	* 38738.9 44524.3 39044.3 44695.3 * 350. 61. AG 2280. 3.5 0.0 44.0	
87. RT58_NB_14	* 39044.3 44695.3 39270.9 44800.8 * 250. 65. AG 2280. 3.5 0.0 44.0	
88. RT58_NB_15	* 39270.9 44800.8 39505.3 44887.8 * 250. 70. AG 2280. 3.5 0.0 44.0	
89. RT58_NB_16	* 39505.3 44887.8 39813.6 44977.3 * 321. 74. AG 3120. 3.5 0.0 44.0	
90. RT58_SB_01	* 39793.4 45061.5 39552.3 44995.4 * 250. 255. AG 1450. 3.5 0.0 44.0	
91. RT58_SB_02	* 39552.3 44995.4 39315.2 44915.9 * 250. 251. AG 1450. 3.5 0.0 44.0	
92. RT58_SB_03	* 39315.2 44915.9 38861.6 44705.7 * 500. 245. AG 1450. 3.5 0.0 44.0	
93. RT58_SB_04	* 38861.6 44705.7 38439.8 44437.2 * 500. 238. AG 1450. 3.5 0.0 44.0	
94. RT58_SB_05	* 38439.8 44437.2 38241.7 44284.7 * 250. 232. AG 1450. 3.5 0.0 44.0	
95. RT58_SB_06	* 38241.7 44284.7 38054.0 44119.6 * 250. 229. AG 1450. 3.5 0.0 44.0	

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

DATE: 11/11/15
TIME: 14:42: 7

LINK VARIABLES

LINK DESCRIPTION * LINK COORDINATES (FT) * LENGTH BRG TYPE VPH EF H W V/C

QUEUE

* X1 Y1 X2 Y2 * (FT) (DEG) (G/MI) (FT) (FT) (VEH) 96. RT58_SB_07 * 38054.0 44119.6 37878.5 43941.5 * 250. 225. AG 1450. 3.5 0.0 44.0 97. RT58_SB_08 * 37878.5 43941.5 37559.8 43556.3 * 500. 220. AG 1450. 3.5 0.0 44.0 98. RT58_SB_09 * 37559.8 43556.3 37428.2 43343.7 * 250. 212. AG 1600. 3.5 0.0 44.0 99. RT58_SB_10 * 37428.2 43343.7 37304.1 43126.7 * 250. 210. AG 1600. 3.5 0.0 44.0 100. RT58_SB_11 * 37304.1 43126.7 37193.8 42902.3 * 250. 206. AG 1600. 3.5 0.0 44.0 101. RT58_SB_12 * 37193.8 42902.3 37100.3 42670.4 * 250. 202. AG 1600. 3.5 0.0 44.0 102. RT58_SB_13 * 37100.3 42670.4 36993.5 42337.1 * 350. 198. AG 1600. 3.5 0.0 44.0 103. RT58_SB_14 * 36993.5 42337.1 36927.1 42075.9 * 270. 194. AG 1600. 3.5 0.0 44.0 * 36927.1 42075.9 36748.9 41348.0 * 749. 194. AG 1760. 3.5 0.0 44.0 104. RT58_SB_15 105. RTAB 01 * 35288.1 44839.8 36082.0 44217.2 * 1009. 128. AG 1000. 6.4 0.0 32.0 * 36254.8 44164.9 35479.0 44810.0 * 1009. 310. AG 760. 5.7 0.0 32.0 106. RTCD_01 107. RTCD_02 * 35479.0 44810.0 35330.8 44900.1 * 173. 301. AG 760. 5.7 0.0 32.0 108. RTF_01 * 39783.8 45118.3 39081.4 44975.8 * 717. 259. AG 250. 3.6 0.0 32.0 109. RTF_02 * 39081.4 44975.8 38335.9 44718.7 * 789. 251. AG 250. 3.6 0.0 32.0 110. RTGH_01 * 38069.8 44483.7 37559.8 43556.3 * 1058. 209. AG 150. 2.9 0.0 32.0 111. RTJK_01 * 38601.3 43812.7 38404.9 43803.3 * 197. 267. AG 290. 3.5 0.0 32.0 112. RTJK_02 * 38404.9 43803.3 38246.1 43919.2 * 197. 306. AG 290. 3.5 0.0 32.0 113. RTJK 03 * 38246.1 43919.2 38234.7 44112.2 * 193. 357. AG 290. 3.5 0.0 32.0 114. RTJK_04 * 38234.7 44112.2 38328.1 44239.4 * 158. 36. AG 290. 3.5 0.0 32.0 115. SADLER IN 01 * 39567.5 44017.0 39454.5 43795.3 * 249. 207. AG 30. 3.9 0.0 32.0 116. SADLER_OUT_01 * 39473.0 43786.9 39578.3 44011.8 * 248. 25. AG 60. 3.9 0.0 32.0 117. SADLER_Q_01 * 39476.0 43837.5 39508.8 43901.9 * 72. 27. AG 12. 100.0 0.0 12.0 1.15 3.7 118. SB_IN_01 * 38335.9 44718.7 38111.7 44587.0 * 260. 240. AG 110. 2.7 0.0 32.0 119. SBSR_OUT_01 * 39454.5 43795.3 39335.9 43573.5 * 252. 208. AG 70. 3.9 0.0 32.0 120. WB_LTQ1_01 * 38888.4 44087.6 38909.7 44076.6 * 24. 117. AG 10. 100.0 0.0 12.0 0.26 1.2 121. WB_LTQ2_01 * 38155.2 44557.8 38181.1 44539.7 * 32. 125. AG 11. 100.0 0.0 12.0 0.66 1.6 122. WB460_B_01 * 37855.3 44796.7 37507.5 45052.0 * 431. 306. AG 580. 2.5 0.0 44.0 123. WBE460_IN_01 * 38862.8 44113.7 39307.4 43892.0 * 497. 117. AG 400. 2.4 0.0 44.0 124. WBE460_OUT_01 * 38862.8 44113.7 38520.1 44322.4 * 401. 301. AG 510. 2.3 0.0 44.0 125. WBE460_Q_01 * 38893.9 44098.2 38928.2 44081.1 * 38. 117. AG 10. 100.0 0.0 24.0 0.22 1.9 126. WBSR_IN_01 * 39771.2 43670.8 39471.2 43815.0 * 333. 296. AG 370. 2.3 0.0 44.0 127. WBSR_LT_01 * 39513.4 43774.8 39648.5 43709.8 * 150. 116. AG 20. 2.3 0.0 32.0 128. WBSR_OUT_01 * 39471.2 43815.0 39307.4 43892.0 * 181. 295. AG 460. 2.3 0.0 44.0 129. WBSR_RT_01 * 39779.0 43687.0 39528.4 43807.5 * 278. 296. AG 20. 2.3 0.0 32.0 130. WBW460_IN_01 * 38138.3 44589.1 38520.1 44322.4 * 466. 125. AG 440. 2.4 0.0 44.0 131. WBW460_OUT_01 * 38138.3 44589.1 37855.3 44796.7 * 351. 306. AG 440. 2.4 0.0 44.0 132. WBW460_Q_01 * 38164.5 44570.8 38187.2 44555.0 * 28. 125. AG 7. 100.0 0.0 24.0 0.20 1.4

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

DATE: 11/11/15
TIME: 14:42: 7

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION * CYCLE RED CLEARANCE APPROACH SATURATION IDLE SIGNAL ARRIVAL

- * LENGTH TIME LOST TIME VOL FLOW RATE EM FAC TYPE RATE
- * (SEC) (SEC) (SEC) (VPH) (VPH) (gm/hr)

_____*____*____* 8. EBSR_Q_01 * 60 55 2.0 1010 1600 4.80 2 3 12. EBW460_Q_01 * 90 29 2.0 880 1600 4.80 2 3 15. NBSR_Q_01 * 60 55 2.0 80 1600 4.80 2 72. RAMPE_Q_01 * 90 67 2.0 360 1600 4.80 2 3 73. RAMPF_Q_01 * 90 73 2.0 110 1600 4.80 2 117. SADLER_Q_01 * 60 55 2.0 30 1600 4.80 2 3 120. WB_LTQ1_01 * 90 73 2.0 60 4.80 2 1600 3 * 90 80 2.0 70 121. WB_LTQ2_01 1600 4.80 2 3 125. WBE460_Q_01 * 90 35 2.0 400 1600 4.80 2 3 132. WBW460_Q_01 * 90 23 2.0 440 1600 4.80 2 3

RECEPTOR LOCATIONS

* COORDINATES (FT) *

RECEPTOR		* X	Υ	Z *
	*			*
1. Rec 1	*	35668.8	44512.0	5.9 *
2. Rec 2	*	36061.6	44202.7	5.9 *
3. Rec 3	*	36401.8	43838.5	5.9 *
4. Rec 4	*	36728.5	43461.4	5.9 *
5. Rec 5	*	36948.9	43069.5	5.9 *
6. Rec 6	*	37005.1	42574.1	5.9 *

7. Rec 7	*	36843.9	41839.6	5.9 *
8. Rec 8	*	36983.4	41805.3	5.9 *
9. Rec 9	*	37179.0	42529.3	5.9 *
10. Rec 10	*	37371.3	42990.1	5.9 *
11. Rec 11	*	37641.8	43443.2	5.9 *
12. Rec 12	*	38037.3	43749.2	5.9 *
13. Rec 13	*	38536.8	43727.6	5.9 *
14. Rec 14	*	38759.9	43845.0	5.9 *
15. Rec 15	*	38883.2	44009.8	5.9 *
16. Rec 16	*	39140.7	44005.7	5.9 *
17. Rec 17	*	38914.2	44112.0	5.9 *
18. Rec 18	*	38694.5	44239.2	5.9 *
19. Rec 19	*	38879.4	44421.8	5.9 *
20. Rec 20	*	39061.5	44593.6	5.9 *
21. Rec 21	*	39261.6	44738.6	5.9 *
22. Rec 22	*	39487.9	44843.0	5.9 *
23. Rec 23	*	39726.4	44918.0	5.9 *
24. Rec 24	*	37144.7	42201.0	5.9 *
25. Rec 25	*	37540.7	42602.8	5.9 *
26. Rec 26	*	37148.1	43238.5	5.9 *
27. Rec 27	*	37284.5	43747.8	5.9 *
28. Rec 28	*	39709.9	45126.0	5.9 *
29. Rec 29	*	39213.3	45023.4	5.9 *
30. Rec 30	*	38742.5	44880.1	5.9 *
31. Rec 31	*	38511.8	44797.8	5.9 *
32. Rec 32	*	38268.2	44728.7	5.9 *
33. Rec 33	*	38169.6	44717.5	5.9 *
34. Rec 34	*	38070.1	44728.0	5.9 *
35. Rec 35	*	37975.9	44761.5	5.9 *

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

DATE: 11/11/15
TIME: 14:42: 7

RECEPTOR LOCATIONS

*		COORDIN	IATES (FT)	*
RECEPTOR		* X	Y Z	*
	_*			*
36. Rec 36	*	37891.2	44814.6	5.9 *
37. Rec 37	*	37726.4	44928.0	5.9 *
38. Rec 38	*	38170.8	44595.4	5.9 *
39. Rec 39	*	38251.8	44536.7	5.9 *
40. Rec 40	*	38332.8	44478.1	5.9 *
41. Rec 41	*	38198.1	44471.9	5.9 *
42. Rec 42	*	38117.1	44530.5	5.9 *
43. Rec 43	*	37672.0	44852.9	5.9 *
44. Rec 44	*	37832.8	44734.0	5.9 *
45. Rec 45	*	37910.0	44670.4	5.9 *
46. Rec 46	*	37987.2	44606.8	5.9 *
47. Rec 47	*	38049.1	44528.2	5.9 *
48. Rec 48	*	38020.3	44432.5	5.9 *
49. Rec 49	*	37918.0	44238.1	5.9 *
50. Rec 50	*	37456.1	43953.6	5.9 *
51. Rec 51	*	36958.1	43920.7	5.9 *
52. Rec 52	*	36520.1	44040.3	5.9 *
53. Rec 53	*	36132.4	44292.0	5.9 *
54. Rec 54	*	35734.3	44605.6	5.9 *
55. Rec 55	*	39380.0	43773.8	5.9 *
56. Rec 56	*	39424.0	43871.4	5.9 *

57. Rec 57	*	39522.7	43982.1	5.9	*
58. Rec 58	*	39572.8	43957.3	5.9	*
59. Rec 59	*	39548.1	43814.8	5.9	*
60. Rec 60	*	39509.7	43730.2	5.9	*

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

MODEL RESULTS

REMARKS: In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND * CONCENTRATION

ANGLE * (PPM)

5. * 0.3 0.3 0.0 0.0 0.1 0.0 0.1 0.3 0.2 0.5 0.4 0.1 0.0 0.0 0.2 0.0 0.0 0.2 0.3 0.3 10. * 0.3 0.3 0.0 0.0 0.0 0.1 0.2 0.3 0.2 0.4 0.4 0.0 0.0 0.0 0.2 0.0 0.0 0.2 0.3 0.3 15. * 0.3 0.3 0.0 0.0 0.0 0.1 0.2 0.2 0.2 0.4 0.5 0.0 0.0 0.0 0.2 0.0 0.0 0.2 0.3 0.3 20. * 0.2 0.3 0.0 0.0 0.0 0.0 0.3 0.1 0.2 0.4 0.5 0.0 0.0 0.0 0.1 0.0 0.0 0.3 0.3 0.4 25. * 0.3 0.3 0.0 0.0 0.0 0.1 0.4 0.1 0.1 0.3 0.3 0.0 0.0 0.0 0.1 0.0 0.0 0.3 0.3 0.4 30. * 0.3 0.3 0.0 0.0 0.0 0.1 0.4 0.1 0.0 0.3 0.3 0.1 0.0 0.0 0.1 0.0 0.0 0.3 0.3 0.4 35. * 0.3 0.3 0.0 0.0 0.0 0.1 0.4 0.0 0.0 0.1 0.3 0.1 0.0 0.0 0.2 0.0 0.0 0.2 0.3 0.4 40. * 0.3 0.3 0.0 0.0 0.0 0.2 0.4 0.0 0.0 0.0 0.1 0.1 0.0 0.0 0.2 0.0 0.0 0.2 0.3 0.4 50. * 0.3 0.3 0.0 0.0 0.0 0.2 0.3 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.2 0.0 0.0 0.1 0.2 0.4 55. * 0.3 0.3 0.0 0.0 0.0 0.2 0.3 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.2 0.0 0.0 0.1 0.1 0.3 $60. \ \ ^* \ \ 0.3 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.1 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.1 \ \ 0.3$ 65. * 0.3 0.3 0.0 0.0 0.0 0.2 0.3 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.1 70. * 0.3 0.2 0.0 0.0 0.0 0.1 0.3 0.0 0.0 0.0 0.1 0.0 0.0 0.0 0.2 0.0 0.0 0.0 0.1 75. * 0.3 0.2 0.0 0.0 0.0 0.1 0.3 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.2 0.0 0.0 0.0 0.0 0.1 $80. \ \ ^*0.3 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.1 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$

(DEGR)* 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

85. * 0.3 0.3 0.0 0.0 0.0 0.2 0.3 0.0 0.0 0.0 0.1 0.0 0.0 0.2 0.0 0.0 0.0 0.0 $95. \ \ ^* \ \ 0.4 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$ 160. * 0.0 0.0 0.0 0.1 0.2 0.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.0 0.0 205. * 0.0 0.0 0.0 0.0 0.0 0.1 0.4 0.4 0.3 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

WIND * CONCENTRATION

ANGLE * (PPM)

(DEGR)* 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

*

225. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.4 0.4 0.2 0.0 0.0 0.0 0.0 0.0 0.0 0.2 0.2 0.3 230. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.4 0.5 0.4 0.3 0.1 0.0 0.0 0.0 0.0 0.0 0.2 0.2 0.3 235. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.4 0.4 0.3 0.3 0.1 0.0 0.0 0.0 0.0 0.0 0.2 0.2 0.4 240. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.4 0.3 0.3 0.4 0.1 0.0 0.0 0.0 0.0 0.0 0.3 0.3 0.4 245. * 0.0 0.0 0.0 0.0 0.0 0.0 0.4 0.3 0.3 0.4 0.1 0.0 0.0 0.0 0.0 0.0 0.3 0.3 0.4 295. * 0.1 0.1 0.0 0.0 0.0 0.0 0.0 0.3 0.3 0.3 0.2 0.0 0.0 0.1 0.0 0.0 0.3 0.3 0.3 300. * 0.1 0.1 0.0 0.0 0.0 0.0 0.0 0.3 0.3 0.3 0.2 0.0 0.0 0.1 0.0 0.0 0.3 0.3 0.3 305. * 0.2 0.2 0.0 0.0 0.0 0.0 0.0 0.3 0.3 0.3 0.2 0.0 0.0 0.2 0.0 0.0 0.1 0.2 0.3 320. * 0.3 0.4 0.1 0.0 0.0 0.0 0.0 0.4 0.3 0.3 0.2 0.1 0.0 0.0 0.2 0.0 0.0 0.1 0.3 0.3 MAX * 0.4 0.4 0.2 0.0 0.1 0.3 0.4 0.5 0.5 0.5 0.5 0.2 0.0 0.0 0.2 0.1 0.2 0.5 0.3 0.5

DEGR. * 95 320 330 5 5 45 25 210 230 5 15 45 5 5 5 280 280 280 5 45

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

MODEL RESULTS

REMARKS: In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND * CONCENTRATION

ANGLE * (PPM)

(DEGR)* 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 $20. \ \ ^*0.4 \ \ 0.3 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$ $25. \ \ ^* \ \ 0.3 \ \ 0.4 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$ $30. \ \ ^* \ \ 0.5 \ \ 0.4 \ \ 0.3 \ \ 0.0 \ \ 0.0 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$ $60. \ \ ^* \ 0.5 \ \ 0.3 \ \ 0.2 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0 \ \ 0.0$

130. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.1 0.4 145. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.2 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.1 0.2 0.4 150. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.2 0.1 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.4 155. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.2 0.1 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.0 0.3

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

WIND ANGLE RANGE: 5,-360.

WIND * CONCENTRATION

ANGLE * (PPM)

MAX * 0.6 0.6 0.4 0.2 0.0 0.1 0.3 0.3 0.3 0.1 0.1 0.0 0.0 0.0 0.0 0.1 0.1 0.1 0.2 0.4

DEGR. * 55 265 5 210 5 95 60 145 105 145 75 5 5 5 5 290 140 130 140 130

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

MODEL RESULTS

REMARKS: In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND * CONCENTRATION

ANGLE * (PPM)

 5. *
 0.1
 0.0
 0.1
 0.1
 0.1
 0.1
 0.1
 0.0
 0.1
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0
 0.0</t

(DEGR)* 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

85. * 0.2 0.1 0.1 0.1 0.1 0.1 0.0 0.1 0.1 0.2 0.2 0.0 0.0 0.1 0.0 0.0 0.0 0.0 0.0 90. * 0.2 0.1 0.1 0.1 0.1 0.1 0.0 0.1 0.1 0.2 0.2 0.1 0.0 0.1 0.0 0.0 0.0 0.0 0.0 95. * 0.2 0.1 0.1 0.1 0.1 0.1 0.0 0.1 0.1 0.2 0.2 0.1 0.0 0.1 0.1 0.0 0.0 0.0 0.0 100. * 0.2 0.1 0.1 0.1 0.1 0.1 0.0 0.1 0.1 0.2 0.2 0.1 0.0 0.1 0.1 0.0 0.0 0.0 0.0 105. * 0.1 0.1 0.1 0.1 0.1 0.1 0.0 0.1 0.1 0.2 0.2 0.2 0.0 0.1 0.1 0.0 0.0 0.0 0.0 120. * 0.2 0.1 0.1 0.1 0.1 0.0 0.0 0.1 0.1 0.1 0.3 0.2 0.1 0.3 0.0 0.0 0.0 0.0 0.0 0.1 125. * 0.2 0.1 0.1 0.1 0.1 0.0 0.0 0.0 0.1 0.1 0.3 0.2 0.1 0.3 0.0 0.0 0.0 0.0 0.0 130. * 0.2 0.1 0.1 0.1 0.0 0.0 0.0 0.0 0.1 0.1 0.3 0.2 0.1 0.3 0.0 0.0 0.0 0.0 0.0 0.0 160. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.1 0.2 0.3 0.3 0.0 0.0 0.0 0.0 0.0 0.0 165. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.1 0.2 0.3 0.3 0.0 0.0 0.0 0.0 0.0 0.0 170. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.1 0.2 0.3 0.3 0.0 0.0 0.0 0.0 0.0 0.0 185. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.1 0.2 0.2 0.3 0.2 0.0 0.0 0.0 0.0 0.0 205. * 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.3 0.1 0.2 0.0 0.0 0.0 0.0 0.0 0.0 210. * 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.3 0.1 0.2 0.0 0.0 0.0 0.0 0.0 0.0

JOB: Route 460 and Route 58 CAL3QHC Runs RUN: 2040 Build AM

WIND ANGLE RANGE: 5,-360.

WIND * CONCENTRATION

ANGLE * (PPM)

(DEGR)* 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 *----* 290. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.3 0.3 0.4 0.0 0.0 0.0 0.0 0.0 0.0 295. * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.0 0.1 0.2 0.3 0.4 0.1 0.0 0.0 0.0 0.1 310. * 0.1 0.1 0.1 0.0 0.0 0.0 0.1 0.0 0.0 0.1 0.2 0.3 0.2 0.0 0.0 0.0 0.2

DEGR. * 80 25 5 5 5 5 5 60 70 120 145 140 135 305 280 5 5 5 300

THE HIGHEST CONCENTRATION OF 0.60 PPM OCCURRED AT RECEPTOR

APPENDIX D. CAL3QHC TABLE OF PEAK CO CONCENTRATIONS BY RECEPTOR FOR EACH ALTERNATIVE (1-HOUR AND 8-HOUR) AT EACH WORST CASE INTERCHANGE.

	CAL3C	HC Results (ppm CO) for the G				odwin I	Bouleva	ard & R	Interch			
		1			ld 2021		2021		ild 2040	Build		
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1-hr Avg	Rec	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	
	1	0.5	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.3	
	2	0.3	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.3	0.3	
	3	0.3	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.3	0.3	
	4	0.3	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	
	5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
	6	0.2	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.1	
	7	0.3	0.4	0.2	0.4	0.2	0.3	0.4	0.4	0.3	0.4	
	8	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	9	0.5	0.6	0.4	0.3	0.4	0.3	0.4	0.4	0.4	0.4	
	10	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.4	
	11	0.4	0.4	0.3	0.4	0.2	0.3	0.4	0.4	0.3	0.4	
	12	0.3	0.4	0.2	0.3	0.2	0.3	0.3	0.4	0.2	0.4	
	13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
	14	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	
	15	0.3	0.4	0.2	0.3	0.2	0.2	0.3	0.4	0.2	0.4	
-	16	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	
-	17	0.2	0.3	0.1	0.3	0.1	0.1	0.2	0.3	0.1	0.2	
	18 19	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	
-	20	0.6	0.6	0.5	0.4	0.5	0.4	0.4	0.4	0.5	0.4	
	21	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
	22	0.6	0.7	0.5	0.6	0.4	0.6	0.5	0.6	0.4	0.6	
	23	0.7	0.8	0.5	0.6	0.5	0.6	0.4	0.6	0.4	0.6	
	24	0.9	0.9	0.5	0.6	0.7	0.7	0.5	0.6	0.5	0.6	
	25	0.9	0.9	0.5	0.6	0.6	0.7	0.6	0.7	0.5	0.7	
	26	0.8	0.8	0.5	0.6	0.6	0.7	0.5	0.7	0.6	0.7	
	27	0.7	0.8	0.5	0.7	0.5	0.7	0.5	0.7	0.5	0.7	
	28	0.7	0.9	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	
	29	0.6	0.7	0.3	0.3	0.3	0.4	0.2	0.6	0.2	0.4	
	30	0.7	0.9	0.3	0.6	0.3	0.6	0.4	0.7	0.3	0.5	
	31	0.7	0.8	0.4	0.5	0.4	0.6	0.5	0.5	0.4	0.6	
	32	0.5	0.6	0.4	0.5	0.3	0.4	0.4	0.5	0.3	0.5	
	33	0.5	0.6	0.3	0.3	0.3	0.4	0.3	0.5	0.3	0.5	
	34	0.6	0.9	0.3	0.5	0.3	0.5	0.4	0.4	0.3	0.4	
	35	0.7	1	0.4	0.5	0.3	0.5	0.4	0.6	0.4	0.5	
	36	0.9	1	0.4	0.6	0.5	0.6	0.4	0.6	0.4	0.7	
	37	0.7	0.8	0.4	0.5	0.4	0.6	0.4	0.5	0.4	0.6	
	38	0.6	0.7	0.3	0.5	0.3	0.5	0.4	0.6	0.3	0.5	
	39	0.3	0.4	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	
	40	0.3	0.3	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.3	
-	41	0.3	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	
	42	0.3	0.5	0.3	0.4	0.3	0.5	0.3	0.4	0.3	0.5	
-	44	0.4	0.6	0.3	0.4	0.3	0.5	0.3	0.5	0.4	0.6	
-	45	0.4	0.5	0.4	0.5	0.4	0.6	0.4	0.6	0.4	0.6	
	46	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.6	0.4	0.5	
	47	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.0	0.4	0.5	
-	48	0.1	0	0	0	0.1	0	0	0	0.1	0	
	49	0	0	0	0	0	0	0	0	0	0	
	50	0	0	0	0	0	0	0	0	0	0	
	51	0	0	0	0	0	0	0	0	0	0	
	52	0	0.1	0	0	0	0.1	0.1	0.1	0.1	0.1	
	53	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1	
	54	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	
	55	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.3	
	56	0.4	0.4	0.3	0.2	0.3	0.3	0.2	0.3	0.2	0.3	
	57	0.4	0.4	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.3	
	58	0	0	0	0	0	0	0	0	0	0	

CAL3QHC Results (ppm CO) for the Godwin Boulevard & Route 58 Interchange												
		Exist	ting	No Bui	ld 2021	Build	2021	No Bu	ild 2040	Build	2040	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
8-hr Avg	Rec	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	
	1	0.35	0.21	0.21	0.21	0.28	0.21	0.21	0.21	0.28	0.21	
	2	0.21	0.21	0.14	0.21	0.14	0.21	0.14	0.21	0.21	0.21	
	3	0.21	0.14	0.14	0.07	0.14	0.21	0.21	0.14	0.21	0.21	
	4	0.21	0.14	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	
	5	0.14	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
	6	0.14	0.14	0.14	0.07	0.14	0.07	0.14	0.14	0.14	0.07	
	7	0.21	0.28	0.14	0.28	0.14	0.21	0.28	0.28	0.21	0.28	
	8	0.49	0.49	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	
-	9	0.35	0.42	0.28	0.21	0.28	0.21	0.28	0.28	0.28	0.28	
-	10	0.21	0.28	0.21	0.21	0.21	0.21	0.21	0.28	0.21	0.28	
	11	0.28	0.28	0.21	0.28	0.14	0.21	0.28	0.28	0.21	0.28	
	12	0.21	0.28	0.14	0.21	0.14	0.21	0.21	0.28	0.14	0.28	
	13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	
	14	0.14	0.21	0.14	0.21	0.14	0.21	0.14	0.21	0.14	0.21	
	15	0.21	0.28	0.14	0.21	0.14	0.14	0.21	0.28	0.14	0.28	
-	16	0.21	0.21	0.14	0.14	0.14	0.14	0.21	0.21	0.14	0.21	
-	17	0.14	0.21	0.07	0.21	0.07	0.07	0.14	0.21	0.07	0.14	
	18	0.14	0.21	0.07	0.21	0.21	0.21	0.14	0.21	0.07	0.14	
	19	0.42	0.42	0.21	0.21	0.35	0.21	0.21	0.28	0.35	0.21	
	20	0.42	0.42	0.33	0.28	0.33	0.28	0.28	0.28	0.33	0.28	
	21	0.42	0.42	0.28	0.28	0.28	0.35	0.28	0.28	0.28	0.35	
-	22	0.43	0.42	0.35	0.42	0.28	0.42	0.35	0.42	0.28	0.42	
	23	0.42	0.49	0.35	0.42	0.35	0.42	0.33	0.42	0.28	0.42	
-					0.42				0.42		0.42	
-	24	0.63	0.63	0.35		0.49	0.49	0.35		0.35		
	25	0.63	0.63	0.35	0.42	0.42	0.49	0.42	0.49	0.35	0.49	
	26	0.56	0.56	0.35	0.42	0.42	0.49	0.35	0.49		0.49	
-	27	0.49	0.56	0.35	0.49	0.35	0.49	0.35	0.49	0.35	0.49	
	28	0.49	0.63	0.35	0.42	0.35	0.42	0.35	0.42	0.35	0.42	
	29	0.42	0.49	0.21	0.21	0.21	0.28	0.14	0.42	0.14	0.28	
	30	0.49	0.63	0.21	0.42	0.21	0.42	0.28	0.49	0.21	0.35	
-	31	0.49	0.56	0.28	0.35	0.28	0.42	0.35	0.35	0.28	0.42	
-	32	0.35	0.42	0.28	0.35	0.21	0.28	0.28	0.35	0.21	0.35	
-	33	0.35	0.42	0.21	0.21	0.21	0.28	0.21	0.35	0.21	0.35	
	34	0.42	0.63	0.21	0.35	0.21	0.35	0.28	0.28	0.21	0.28	
	35	0.49	0.7	0.28	0.35	0.21	0.35	0.28	0.42	0.28	0.35	
-	36	0.63	0.7	0.28	0.42	0.35	0.42	0.28	0.42	0.28	0.49	
	37	0.49	0.56	0.28	0.35	0.28	0.42	0.28	0.35	0.28	0.42	
	38	0.42	0.49	0.21	0.35	0.21	0.35	0.28	0.42	0.21	0.35	
-	39	0.21	0.28	0.07	0.21	0.07	0.21	0.07	0.21	0.07	0.21	
-	40	0.21	0.21	0.07	0.14	0.07	0.14	0.14	0.21	0.14	0.21	
	41	0.21	0.35	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.28	
	42	0.21	0.35	0.21	0.28	0.21	0.35	0.21	0.28	0.21	0.35	
	43	0.28	0.42	0.21	0.28	0.21	0.35	0.21	0.35	0.28	0.42	
	44	0.28	0.35	0.28	0.35	0.28	0.42	0.28	0.42	0.28	0.42	
	45	0.28	0.35	0.28	0.35	0.28	0.42	0.28	0.42	0.28	0.42	
	46	0.28	0.35	0.28	0.35	0.28	0.35	0.28	0.42	0.28	0.35	
	47	0.07	0	0	0	0.07	0	0	0	0.07	0	
	48	0.07	0	0	0	0	0	0	0	0	0	
	49	0	0	0	0	0	0	0	0	0	0	
	50	0	0	0	0	0	0	0	0	0	0	
	51	0	0	0	0	0	0	0	0	0	0	
	52	0	0.07	0	0	0	0.07	0.07	0.07	0.07	0.07	
	53	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0	0.07	0.07	
	54	0.14	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	
	55	0.21	0.21	0.14	0.14	0.14	0.21	0.14	0.14	0.14	0.21	
	56	0.28	0.28	0.21	0.14	0.21	0.21	0.14	0.21	0.14	0.21	
	57	0.28	0.28	0.21	0.14	0.21	0.21	0.14	0.14	0.14	0.21	
	58	0	0	0	0	0	0	0	0	0	0	

		CAL3Q	HC Resu	lts (ppm	ni At Rou							
		Existing No Build 20			ld 2021	Build	2021	No Bui	No Build 2040 Build 2040			
		AM	PM	AM PM AM PM			AM	PM	AM PM			
1-hr Avg	Rec	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	
	1	0	0	0	0	0.3	0.4	0	0	0.4	0.5	
	2	0	0	0	0	0.4	0.4	0	0	0.4	0.5	
	3	0	0	0	0	0	0.2	0	0	0.2	0.3	
	4	0	0	0	0	0	0	0	0	0	0.1	
	5	0.1	0.1	0	0.1	0	0.1	0	0.1	0.1	0.2	
	6	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.4	
	7	0.5	0.8	0.4	0.6	0.4	0.6	0.4	0.6	0.4	0.6	
	8	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.4	0.5	0.5	
	9	0.6	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.4	
	10	0.6	0.5	0.4	0.4	0.5	0.3	0.4	0.4	0.5	0.3	
	11	0.6	0.5	0.4	0.3	0.4	0.3	0.4	0.4	0.5	0.3	
	12	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2	
	13	0.2	0	0.1	0	0	0	0.1	0	0	0	
	14	0	0	0	0	0.1	0.1	0	0	0	0	
	15	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0	0.2	0.1	
	16	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	
	17	0.4	0.4	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.3	
	18	0.2	0.3	0.2	0.2	0.5	0.5	0.2	0.2	0.5	0.4	
	19	0.2	0.2	0.1	0.2	0.3	0.3	0.1	0.2	0.3	0.5	
	20	0.3	0.3	0.2	0.2	0.4	0.5	0.2	0.2	0.5	0.5	
	21	0.5	0.5	0.3	0.4	0.5	0.5	0.3	0.4	0.6	0.7	
	22	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.4	0.6	0.6	
	23	0.6	0.6	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.5	
	24	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.3	
	25	0.1	0.1	0	0	0	0	0	0	0	0.1	
	26	0.2	0.2	0.1	0.1	0	0.2	0.1	0.1	0.1	0.2	
	27	0	0.1	0	0	0.2	0.3	0	0.1	0.3	0.4	
	28	0.4	0.4	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.5	
	29	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.4	
	30	0.2	0.2	0.1	0.1	0	0.2	0.1	0.1	0.1	0.3	
	31 32	0.2	0.2	0.1	0.2	0	0.3	0.2	0.2	0.1	0.3	
	33	0.2	0.3	0.2	0.2	0	0	0.2	0.2	0		
	34	0.2	0.3	0.1	0.2	0	0	0.1	0.2	0	0	
	35	0.3	0.3	0.1	0.2	0	0	0.1	0.1	0	0.1	
	36	0.3	0.3	0.1	0.2	0	0.1	0.3	0.3	0.1	0.1	
	37	0.2	0.3	0.2	0.1	0	0.1	0.2	0.3	0.1	0.1	
	38	0.4	0.4	0.2	0.1	0	0.1	0.2	0.3	0.1	0.1	
	39	0.4	0.4	0.3	0.2	0.1	0.3	0.3	0.3	0.2	0.3	
	40	0.4	0.5	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.5	
	41	0.4	0.4	0.2	0.2	0.3	0.4	0.3	0.3	0.4	0.3	
	42	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.3	0.1	0.3	
	43	0.3	0.3	0.2	0.2	0.1	0.1	0.3	0.3	0.1	0.2	
	44	0.3	0.3	0.3	0.2	0.1	0.1	0.3	0.3	0.1	0.2	
	45	0.3	0.3	0.2	0.2	0.1	0.1	0.3	0.3	0.1	0.1	
	46	0.3	0.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	
	47	0.2	0.2	0.1	0	0.1	0.1	0.1	0.1	0	0.1	
	48	0.1	0.2	0	0.1	0.2	0.4	0	0.2	0.1	0.3	
	49	0.2	0.3	0	0.2	0.1	0.2	0	0.2	0.1	0.3	
	50	0	0.1	0	0	0.2	0.3	0	0	0.2	0.4	
	51	0	0	0	0	0.2	0.3	0	0	0.3	0.4	
	52	0	0	0	0	0.3	0.4	0	0	0.3	0.6	
	53	0	0	0	0	0.3	0.5	0	0	0.3	0.5	
	54	0	0	0	0	0.4	0.6	0	0	0.4	0.7	
	55	0.1	0	0.1	0	0.2	0.1	0.1	0	0.2	0.1	
	56	0	0.1	0	0.1	0.1	0.2	0	0.2	0.1	0.2	
	57	0	0	0	0	0	0.1	0	0	0	0	
	58	0	0	0	0	0	0.1	0	0	0	0	
	59	0	0.1	0	0.1	0.1	0.1	0	0.1	0	0.1	
	60	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.1	

	CAL3QHC Results (ppm CO) for the Eastern Termini At Route 58 Interchange											
		Existing No Build 2021			Build		No Bui		Build			
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
8-hr Avg	Rec	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	
	1	0	0	0	0	0.21	0.28	0	0	0.28	0.35	
	2	0	0	0	0	0.28	0.28	0	0	0.28	0.35	
	3	0	0	0	0	0	0.14	0	0	0.14	0.21	
	4	0	0	0	0	0	0	0	0	0	0.07	
	5	0.07	0.07	0	0.07	0	0.07	0	0.07	0.07	0.14	
	6	0.28	0.28	0.21	0.28	0.21	0.21	0.21	0.28	0.21	0.28	
	7	0.35	0.56	0.28	0.42	0.28	0.42	0.28	0.42	0.28	0.42	
	8	0.42	0.35	0.28	0.28	0.35	0.35	0.35	0.28	0.35	0.35	
	9	0.42	0.35	0.28	0.28	0.28	0.28	0.35	0.28	0.35	0.28	
	10	0.42	0.35	0.28	0.28	0.35	0.21	0.28	0.28	0.35	0.21	
	11 12	0.42	0.35	0.28	0.21	0.28	0.21	0.28 0.14	0.28	0.35	0.21	
	13	0.14	0.14	0.14	0.07	0.14	0.14	0.14	0.07	0.14	0.14	
	14	0.14	0	0.07	0	0.07	0.07	0.07	0	0	0	
	15	0.14	0.14	0.07	0.07	0.14	0.14	0.07	0	0.14	0.07	
	16	0.07	0.07	0.07	0.07	0.07	0.14	0.07	0.07	0.07	0.14	
	17	0.28	0.28	0.07	0.14	0.14	0.21	0.07	0.14	0.14	0.21	
	18	0.14	0.21	0.14	0.14	0.35	0.35	0.14	0.14	0.35	0.28	
	19	0.14	0.14	0.07	0.14	0.21	0.21	0.07	0.14	0.21	0.35	
	20	0.21	0.21	0.14	0.14	0.28	0.35	0.14	0.14	0.35	0.35	
	21	0.35	0.35	0.21	0.28	0.35	0.35	0.21	0.28	0.42	0.49	
	22	0.42	0.35	0.28	0.28	0.35	0.35	0.35	0.28	0.42	0.42	
	23	0.42	0.42	0.28	0.28	0.28	0.35	0.35	0.28	0.28	0.35	
	24	0.21	0.21	0.14	0.21	0.14	0.14	0.14	0.14	0.14	0.21	
	25	0.07	0.07	0	0	0	0	0	0	0	0.07	
	26	0.14	0.14	0.07	0.07	0	0.14	0.07	0.07	0.07	0.14	
	27	0	0.07	0	0	0.14	0.21	0	0.07	0.21	0.28	
	28	0.28	0.28	0.14	0.21	0.21	0.28	0.21	0.21	0.21	0.35	
	29	0.21	0.21	0.14	0.14	0.14	0.21	0.14	0.14	0.21	0.28	
	30 31	0.14	0.14	0.07	0.07	0	0.14	0.07 0.14	0.07	0.07	0.21	
	32	0.14	0.14	0.07	0.14	0	0.21	0.14	0.14	0.07	0.21	
	33	0.14	0.21	0.07	0.14	0	0	0.07	0.14	0	0	
	34	0.14	0.21	0.07	0.14	0	0	0.07	0.07	0	0	
	35	0.21	0.21	0.07	0.14	0	0	0.21	0.14	0	0.07	
	36	0.21	0.21	0.14	0.14	0	0.07	0.21	0.21	0.07	0.07	
	37	0.14	0.21	0.14	0.07	0	0.07	0.14	0.21	0.07	0.07	
	38	0.28	0.28	0.14	0.14	0	0.07	0.14	0.21	0.07	0.14	
	39	0.28	0.28	0.21	0.14	0.07	0.21	0.21	0.21	0.14	0.21	
	40	0.28	0.35	0.28	0.21	0.28	0.28	0.28	0.28	0.28	0.35	
	41	0.28	0.28	0.14	0.14	0.21	0.28	0.21	0.21	0.14	0.21	
	42	0.21	0.21	0.14	0.14	0.14	0.21	0.14	0.21	0.07	0.21	
	43	0.21	0.21	0.14	0.14	0.07	0.07	0.21	0.21	0.07	0.14	
	44	0.21	0.21	0.21	0.14	0.07	0.07	0.21	0.21	0.07	0.14	
	45 46	0.21	0.21	0.14	0.14	0.07	0.07	0.21 0.07	0.21	0.07	0.07	
	46	0.21	0.21	0.07	0.14	0.07	0.07	0.07	0.07	0.07	0.07	
	48	0.14	0.14	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
	49	0.07	0.14	0	0.07	0.14	0.14	0	0.14	0.07	0.21	
	50	0	0.07	0	0	0.14	0.21	0	0	0.14	0.28	
	51	0	0	0	0	0.14	0.21	0	0	0.21	0.28	
	52	0	0	0	0	0.21	0.28	0	0	0.21	0.42	
	53	0	0	0	0	0.21	0.35	0	0	0.21	0.35	
	54	0	0	0	0	0.28	0.42	0	0	0.28	0.49	
	55	0.07	0	0.07	0	0.14	0.07	0.07	0	0.14	0.07	
	56	0	0.07	0	0.07	0.07	0.14	0	0.14	0.07	0.14	
	57	0	0	0	0	0	0.07	0	0	0	0	
	58	0	0	0	0	0	0.07	0	0	0	0	
	59	0	0.07	0	0.07	0.07	0.07	0	0.07	0	0.07	
	60	0.14	0.14	0.07	0.07	0.14	0.07	0.07	0.14	0.21	0.07	

